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The Mining Magazine

Edited by T. A. RICKARD.

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INDEX TO VOLUME II.

FROM JANUARY TO JUNE 1910

EXPLANATORY NOTE.—Items in italics are names of books reviewed ; illustrated articles are denoted by asterisks (*) ; the letters (*c.l.*) refer to notice of articles under the heading 'Current Literature' ; the letters (*p.t.*) to abstracts appearing in 'Précis of Technology.'

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The Mining Magazine

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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CONTENTS.

REVIEW OF MINING

THE year 1910 starts cheerfully. An era of industrial expansion is assured, unless unforeseen circumstances arise to disturb the peace of the world. Industrial development calls for the metals and thereby directly stimulates mining. Civilization rolls forward on iron wheels, the interchange of news and of commodities is aided by copper, for coinage and decoration the race needs gold and silver, for domestic and architectural purposes the use of lead and zinc is required—in short, the basis of the art of modern living is metallic. Thus the growth of confidence, the widening of trade, the quickening of commerce are reflected in the speculative activities of the mineral explorer and mine operator. In continental Europe, especially Germany, trade is better, with indications of continued rebound from recent heaviness.

TRADE PROSPECTS.—A sign of the times is the purchase of diamonds. It is said that Disraeli measured industrial prosperity by the consumption of sulphuric acid, and in later days Lord Rothschild has selected the demand for diamonds as the most reliable indicator of trade revival. The market for brilliants is a barometer of luxury just as the iron market is the surest index of expanding commerce. In America especially a period of pronounced activity is in sight, after recovery from financial depression, and all the untiring energies of a resourceful people are bent upon the continued development of a continent. In Canada the extension of railways gives access to new mineral regions. In Mexico and South America similar railway enterprise promises increased facilities for the exploitation of minerals in the Cordilleras. In Central America the political conditions are perturbed, as is usual in the isthmian region, but there is promise of an era of more orderly government, such as will encourage the establishment of industry. In Africa—South, West, and Centre—the stability of splendid mining enterprises continues concurrently with the discoveries of new lines of 'banket,' additional copper lodes, tin veins, and diamond pipes. In Australia a temporary paralysis due to a strike of coal miners marked the end of 1909, but this episode is ended and the general prosperity of the federated States continues on an ascending scale, by reason of good crops, a big wool clip, and widespread mineral resources.

In the British Isles the general election begins on the day this Magazine is issued ; and for a brief period the responsibilities of the elector will interfere with the course of business. But this is a temporary condition, unlikely adversely to affect an occupation so absorbing as mining and the speculation incidental thereto. Whichever party wins the election and whatever the verdict of the polls, the essential common-sense of the British people will assert itself and the national imperturbability will be restored after a flutter of political excitement. No change of government will destroy industry and no change of policy is likely to cripple the persistent search for minerals in all the various regions where British capital and British energy are being successfully applied.

CAPITAL.—During 1909 London has regained prestige as the greatest market for capital and it has become apparent that the British people are so prosperous as to be saving £350,000,000 per annum, one half of which is invested in new securities. This fact is elucidated by *The Statist*, which publishes statistics indicating that in 1909 the total capital publicly subscribed by Great Britain was £213,767,800 as against £206,410,500 in 1908, and £130,645,600 in 1907. For mines £8,410,600 was subscribed, as against £5,602,800 in 1908 and £3,554,300 in 1907.

And the money thus raised has not come from the sales of land or former investments, but from new savings of the people.

TRANSVAAL.—The statistics for 1909 show that the output was 7,280,542 oz., an increase of 227,925 oz. as compared to 1908. The value of the gold produced in 1909 is £30,925,788, an increase of one million sterling. It will be noted that each of the first nine months of 1909 showed a gain as compared to the corresponding month in 1908, whereas October, November, and December each exhibit a corresponding decrease. The yield for December was only 604,987 oz. as against 660,643 oz. in the last month of 1908. This is due in part to the diminished transfer from gold reserves, which have been depleted in accord with the policy to carry less bullion in stock. The relative decline in production during the last quarter is also due to the scarcity of labour. At the close of the year the Chinese had been repatriated and 172,000 natives were employed, as against 12,275 Chinese and 164,826 Kaffirs at the end of 1908. Thus there is a net loss, even without making allowances for the greater efficiency of the Chinese still remaining in December a year ago. As regards white labour 22,500 are now employed, this being 3000 more than a year ago. Meanwhile new undertakings have created further demand for labour, accentuating the shortage. At the present time 71 companies are at work, operating 9610 stamps, crushing 1,800,000 tons per month, yielding 28s. per ton. This compares with 67 companies, 9055 stamps, 1,700,000 tons, and a yield of 29½ shillings a year ago. On the other hand, efficiency, as measured by costs and extraction, is better, so that the profits earned are considerably higher, the dividends declared for 1909 being £9,509,766 as against £8,751,282 in 1908. Gold mining in the Transvaal is prospering and improving, but not expanding.

WEST AFRICAN news continues good. An effort has been made to excite public interest in this department of the mining market, but dealings are largely of a professional character. The basis for a boom is too narrow and the number of good mines available as counters for speculative activity is as yet too few. The artificial nature of the market was shown by the nervous spasm caused by Mr. W. Fischer Wilkinson's letter to *The Times*, in which that able mining engineer sounded a note of warning against premature inflation of ideas concerning Gold Coast mining. Some confusion of identity ensued as between the author of this letter and Mr. Arthur Wilkinson, who, as consulting engineer to several West African companies, has recently committed himself to statements of decidedly cheerful import. The incident has provoked a discussion in the financial Press and, at least, has emphasized a useful moral: *Chi va piano, va sano.* The injection of a little caution is just what is needed at a time when prospects in West Africa are so good as to invite an exaggerated optimism.

The most notable feature of gold mining in 1909 has been this revival of interest in West Africa. Recent developments have changed the entire status of the industry on the Gold Coast. In the Tarkwa and Prestea ranges, the extent of the orebodies has been proved to be greater than was supposed, and active measures are being taken to develop low-grade properties capable of being worked profitably on a large scale. Control has been secured at Prestea by Wernher, Beit & Co., and at some of the Tarkwa mines, such as Cinnamon Bippo and Abbontiakoon, by the Consolidated Gold Fields of South Africa. The mines are being opened up and extensive plant has been ordered. At the Ashanti Goldfields estate, further north, the discovery of rich ore under the old Obuasi workings has changed the whole complexion of the enterprise; furthermore, within the last few weeks an important discovery has been made in another part of the mine with indications that the rich ore persists downward. Malarial conditions in West Africa are being combated at several points, notably at Prestea, by clearing the brush and draining the ground. Another drawback, namely, the scarcity of labour, is being taken in hand, and an association is being formed for the purpose of recruiting, on a plan similar to that in vogue on the Rand.

MEXICO.—Matters in Mexico are improving. That country felt the panic later than the United States and is correspondingly slow in recovering. The Mexican railroads are showing increased earnings and there is a better feeling in mining, though the low price of silver has been a depressing factor. The rapid extension of power-lines to the different mining centres is lessening the cost of production and is stimulating large operations. Eventually the system of taxation in vogue throughout Mexico is bound to be changed, lessening the burden on the mines and shifting it upon the land, which at present pays a merely nominal tax, and for that reason is held in large tracts.

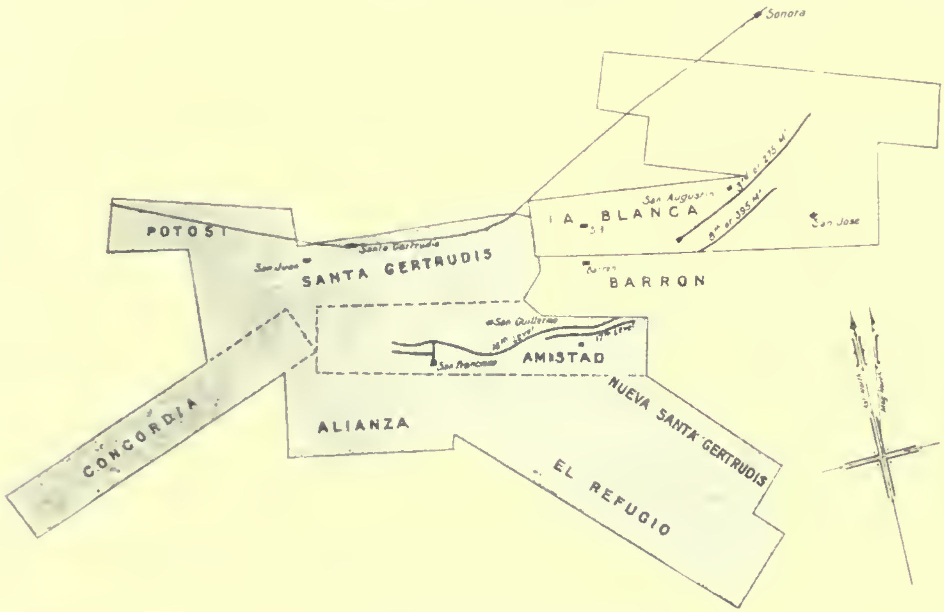
The most interesting event in connection with Mexican mining is the completion of the arrangements for the purchase of the Santa Gertrudis mine, at Pachuca, by the Camp Bird company. This has been completed on the terms announced in these columns last September. The Camp Bird company acquiries 1,155,822 shares in a new company called the Santa Gertrudis Co., Ltd., which has a registered capital of £1,275,000 in £1 shares. To effect the purchase and to provide for the extra working capital of £150,000, the Camp Bird increases its share capital to £1,350,000, as against the £820,000 issued at the time of purchasing the Camp Bird mine in 1900. The additional funds needed for the Mexican business are obtained by an issue of £500,000 in 6% debentures and £280,000 in ordinary £1 shares. The Santa Gertrudis cost £922,131 or 9,000,000 pesos. Sundry commissions were paid, as specified in the prospectus, and we refer to one of them elsewhere. The financial scheme was mainly in the hands of Mr. A. M. Grenfell, the chairman, who, through the Canadian Agency, underwrote all the 280,000 shares and half of the debentures at a discount. The other directors were interested as sub-underwriters. All of which is stated in the prospectus, as required by law. It remains to add that the issue was a great success, being quickly over-subscribed. The debentures are now quoted at a premium; and this is not surprising seeing that they are secured by the profits of both mines, the Camp Bird and the Santa Gertrudis. Further particulars will be found under 'Company Reports.' It will be noted that the Santa Gertrudis is predominantly a silver mine, for the proportion of gold is small, namely, one tenth of the value. Another interesting fact is that the appraisal is based on ore most of which is below the sixteenth level. It is rarely that a mine is placed on the market at so late a stage in its development; and while such maturity may lessen the chances of disappointment, it also diminishes the probability of expansion.

CORNWALL.—Owing to excellent developments in the deep workings at Dolcoath, the greater activity at Carn Brea and Tincroft, and the increased output of South Crofty, the production of tin in Cornwall has increased during 1909. The amount of concentrate sold at the ticketings was 6910 tons, as compared with 6520 tons in 1908 and 5722 tons in 1907. The average price obtained was £77. 10s. 6d. per ton, which is almost identical with the figure for 1908. A notable point is that the price of tin has been slowly creeping upward during the last few months, and at the last ticketing in December the price obtained for best quality concentrate was approximately £95. Two old mines, East Pool and West Kitty, have fallen off recently, but it is gratifying to be able to record that South Crofty, one of the mines recently re-organized under modern principles, has made a profit during 1909 and has declared a dividend of 15%. Otherwise there is no good news relating to new or newly opened mines. The commencement of negotiations in connection with the exploitation of tin gravel by means of dredges promises to lead to an interesting new departure in Cornish operations.

INDIA.—The production of the Indian gold mines during 1909 was 563,888 oz., as compared 555,889 oz. in 1908. The Mysore mine continues to head the list, with 19,000 oz. per month, and Champion Reef, Nundydroog, and Ooregum follow with 9500 oz., 7500 oz., and 7300 oz. per month respectively. The December return at Ooregum was as high as 12,500 oz., which is explained by the fact that the unusual surplus of 5000 oz. was removed from the plates. The main features of the year in connection with Indian gold mining have been (1) the improvement in the bottom levels of the Champion Reef after a period of poor returns; (2) the exhaustion of the ore at Dharwar and the failure to treat the tailing by cyanide on account of the presence of graphite; and (3) the hopeful developments in the Anantapur district.

AUSTRALASIA. The output of gold from Western Australia was 1,595,341 oz. in 1909, against 1,647,912 oz. in 1908. No new mines of importance have been developed, but the deep mines at Kalgoorlie are doing well at 2500 and 2600 ft. New Zealand yielded 506,968 oz. during the past year, this being a gain of 545 oz. as compared to 1908. The total yield of silver was 1,813,831 oz., which is a gain of 82,495 ounces.

The only other figures relating to the output of gold in Australasia that are to hand at the time of going to press are those for New South Wales. The figures for December were 25,084 oz. valued at £92,095. This brings the year's yield to 238,047 oz. valued at £869,546. The total amount of gold won in this state since the beginning of mining has been 13,463,502 oz. valued at £57,189,282.



MAP OF THE SANTA GERTRUDIS PROPERTY.
Scale 1100 ft. to the inch.

COPPER.—Statistics for December indicate a slight curtailment of production in America, due in part to the labour troubles in Montana. American exports of copper for 1909 reached a total of 680,922,000 lb., which is 30,000,000 lb. in excess of 1908; but these figures are not as cheerful as they look, because only 556,230,000 lb. was consumed abroad as against 569,705,000 lb. in 1908.

Stocks of surplus copper on January 1, 1909, were 122,357,266 lb. but on the first day of 1910 they are estimated to be 144,003,500 lb. This accumulation of copper in Europe renders inevitable a forced liquidation unless production is checked. Meanwhile the American combine is not yet completed, although several preliminary consolidations have been effected. Among these we mention the Amalgamated and the Cole-Ryan groups of mines in Montana, and the Boston Consolidated with the Utah Copper Co. Opposition has been shown on the part of minority shareholders not participating in the financial loot incidental to these manipulations of capital. These schemes of amalgamation may aid effective control of production, but as yet they have had more effect on share quotations than on copper output. The American production for 1909 is estimated at 1,410,000,000 lb., which is an increase of 235,000,000 over 1908.

SILVER.—During the past year the average price of silver fell to a figure that is the lowest ever recorded, but otherwise the market fluctuated between narrow limits. The average quotation for standard silver was $23\frac{11}{16}$ pence, as compared with $24\frac{13}{32}$ pence in 1908 and $30\frac{3}{16}$ in 1907. The lowest average previously recorded was $24\frac{1}{4}$ in 1902. The minimum quotation in 1909 was $23\frac{1}{16}$, in March and again in October, while the maximum was $24\frac{7}{8}$ in May, so that the range was less than two pence, as compared to 5d. in 1908 and $8\frac{1}{4}$d. in 1907. Shipments to India continue to be an important factor, but gold is being more utilized for hoarding, a native custom weakened by the spread of education. Thus in future India will be less a sink for silver. Increased purchases from China proved stimulating; it is believed that the development of the industrial resources of the Chinese empire, especially Manchuria, will call for additional supplies of currency, but it is not expected that this will cause any substantial rise in the price of silver under present circumstances. Acute fluctuations are unlikely because speculators in the East carry large stocks of the metal. Nor is the tendency of production favourable; although the yield from Broken Hill and from the Cœur d'Alene may shrink shortly for causes that are not obscure, it is apparent that Cobalt and the other new districts in Ontario are increasing their output and the high price of lead tends to stimulate the mining of ores containing silver. The chief menace to the silver market, however, is the steadily increasing quantity of silver obtained as a by-product in copper mining all over the world; this source of production furnishes a continually augmenting proportion of all the silver produced. This fact, together with the general adoption of the gold standard by countries formerly using a bi-metallic currency, points to a further slow decline in the price of silver. No sudden drop in anticipated, but each relapse is less likely to be followed by complete recovery.

LEAD MINING ought to be attractive at this time. No new lead mines of any importance are being developed. The yield of lead from Broken Hill will decline as soon as the accumulated tailing has been exhausted. In the United States the production is likely to decrease. The largest producer, the Federal Mining & Smelting Co., in northwestern Idaho, will be diminishing its output, for the deepest of the mines controlled by this company are near the slate formation, in which two of the Cœur d'Alene lodes have already come to an end. Meanwhile the duty on imported lead protects the American miner so that the price, now about $4\frac{1}{2}$ cents per pound at New York, would have to rise to 6 cents before the foreigner could scale the tariff wall. The United States consumes all its domestic production and imports a small amount from the outside. As the industrial expansion of the country becomes accentuated again, the demand for lead will increase. The position of lead is strong enough to stimulate the search for the metal all over the world.

EDITORIAL

OWING to the fortuities of time and place some of the comments on articles appearing in our first issue have only reached us in time to appear in the present issue. Mining is world-wide in its geological distribution and our readers are found in the uttermost parts of the earth. In the discussion department we publish letters from Dawson, Nicaragua, Zacatecas, Salt Lake City, and Boston. We have heard of this Magazine being found by one friend in a grocer's shop on the borders of Natal, by another in a railway station on the Balsas river, Mexico, and by a third on a trans-andine train in Peru. Stranger places even than these must have been reached by some of the copies sent out from London, and, in truth, this distribution is not remarkable save as it exemplifies the wide range of mining activity. Trade follows the flag, but the flag follows the pick.

UPON December 14 the Chinese Minister to France attended the Paris office of the International Board of Weights and Measures for the purpose of taking possession, on behalf of China, of the standards of weights and measures according to the metric system. Henceforth the metric system will be compulsory throughout the Chinese Empire. Owing to the confusion created by the great number and variety of weights and measures prevalent in China, a law was recently enacted enforcing the use of the metric system. Hence the ceremony at Paris to which we refer. We hope that the example of a country usually quoted as the victim of hide-bound customs will not be lost upon us, and that the day may come when our antiquated and perplexing weights and measures will give way to a uniform system, intelligible, and applicable to the multifarious needs of trade and industry.

THE death of D. O. Mills removes a man prominently and honourably connected with mining enterprise. He was in control of the Alaska Treadwell, Alaska Mexican, and Alaska United group of mines, and he was a dominant shareholder in the Bunker Hill & Sullivan, a great silver-lead mine in Idaho, besides possessing an interest in the Oriental Consolidated (Korea), the Cerro de Pasco (Peru), and in other undertakings in various parts of the world. As a pioneer trader and banker in California, he early acquired large mining interests and throughout his long life he administered his increasing property with kindly good sense as well as great shrewdness. He was a credit to the country that gave him extraordinary opportunities for acquiring wealth, for in him the good citizen was not lost in the financier.

ELSEWHERE we publish an article on the possibility of the manufacture of steel in the Transvaal. This article, by Mr. Donald F. Campbell, bears evidence of being well informed and warrants careful reading at this time, when, as is already known, the Transvaal Government has instituted an investigation at the hands of Mr. F. W. Harbord, a specialist needing no endorsement from us. We note that in a memorandum submitted on March 8, 1909, the Government Mining Engineer, Mr. R. N. Kotze, stated that "there is a profitable and immediate field for the class of products of electric furnaces which can turn out high-class steel with a comparatively small output per unit" and, in the same memorandum, he recommended that a prohibitive duty or railway rate be imposed upon the export of scrap-iron and steel such as will "form valuable raw materials for working up into steel in the electrical furnace."

THE OCTOBER and November meetings of the Institution of Mining and Metallurgy were marked by excellent technical discussions, but a large part of the time occupied by the December meeting was devoted to a kind of talking that serves no useful purpose. A paper entitled 'Tin-Production in the Province of Yunnan, China,' had been presented by Mr. W. F. Collins. The paper itself was an excellent account of the crude methods of mining and smelting in vogue in a distant corner of the earth; it was interesting from archeological and anthropological points of view, and if the technology involved was of no particular moment, we do not blame the author. Our criticism is in no way directed against his performance, which was as modest as it was creditable. But after an interesting series of magic-lantern pictures, the time of the meeting was consumed by this, that, and the other member rising to state that he had been in China, in the Malay States, in Borneo, or somewhere thereabouts, and had seen similar methods of mining and ore treatment. Beyond eliciting the interesting fact that a number of worthy gentlemen had travelled far, this talk reminded us of Talleyrand, who on being asked on leaving a conference what had passed or transpired, answered: "Three hours." Fortunately less time was lost at Burlington House, but we do protest against the mere iteration of descriptions devoted to the antediluvian methods of ignorant natives. The crude practices of aboriginal peoples as regards placer mining, tin-dressing, and gold-washing are much the same in China, Borneo, Mexico, or Peru. They are the simple processes that Jason used, that Herodotus describes, and that the moderns try so hard to avoid. If the discussion had turned upon the principles involved in the cycloidal curve of the Yunnan buddle, or if the elementary socialism of the native miners had been elucidated to the point of a suggestive lesson, we would have listened patiently to the exchange of reminiscences; but for members of a leading technical society merely to repeat traveller's tales of aboriginal incapacity is but a ploughing of the sand. It is futile.

Counsels of Imperfection.

We take pleasure in publishing a letter from Mr. H. C. Hoover, who comes to the support of Mr. John Hays Hammond. In our last issue we took exception to advice given by the latter in a public address to mining students, especially the advice to participate in the activities and profits of the promoter. Our readers will note that both these gentlemen hold that the trade of the promoter can be best purified by the injection of the mining engineer into the financial hurly-burly. It is likely that many will agree with them, and many more will envy them an unquestioned success in illustrating the application of their own ideas of what befits the mining profession. Certainly the argument gains immensely in dignity by being advocated from such quarters, and we give space to it with no less alacrity because it supports a proposal so distasteful to us. There will be many of our readers in agreement with Messrs. Hammond and Hoover, and many who would be unwilling to say so are nevertheless in accord with them in practice. Yet we remain convinced that the suggestion that the engineer become promoter, that the members of our profession assume the work of the financial trader, and that the young student start life with this avowed purpose in view, is a regrettable retrogression. Even if grown men do as they think fit, we hold it an unfortunate misuse of authority and reputation to lead the youngsters into the shoals of speculation and the deep waters of financial scheming. Adults may smoke, for instance, without particular harm, and most of us expect our sons to smoke, but would we tell a boy in his teens to smoke, knowing that he will do so in proper time, and that if the habit be formed too early it may prove injurious to his physical development? The simile need not be elaborated. Whether it be right for Messrs. Hammond, Hoover, or other men as experienced, as shrewd, and as honourable to engage in promotion is one question, but assuredly it is quite another matter to advise inexperienced youths, about to begin their apprenticeship, to take part in the most dangerous, if the most lucrative of trades, and to turn their backs on the best traditions of the profession. Once adopted the idea of financial participation is only too likely to enfeeble the engineering faculties of the student and to throw him into an arena for which he has had no special training. Scientific teaching and technical instruction are no preparation for the game to which our young graduates are now invited; they waste their time; let them study diplomacy and poker, let them investigate freezeouts and booms, let them read the tape and watch the ticker, let them cultivate the glad hand and the cold heart. What is the use of poring over miserable books and listening to wearisome lectures? There are short cuts to the making of money and easy ways of acquiring great wealth.

It will not do. This proposal to turn the profession into a trade is a pernicious suggestion and must be recognized in all its sinister aspects. The undermining of every ethical principle by the haste to make money has gone far enough, on both sides of the Atlantic, and when it is proposed to poison the very springs of professional integrity at our schools of mines, and to vitiate the entire purpose of scientific teaching, we protest unhesitatingly.

Commissions to Engineers.

We had written the preceding comment on the relation of the profession of the engineer to the trade of the promoter, when the publication of the Camp Bird prospectus furnished an illustration very much to the point. Among the contracts cited is one whereby Mr. Hammond and "his associates" are paid $580,000, or £119,178 in shares for transferring an option on the Santa Gertrudis mine, now purchased by the Camp Bird company. In addition to the sum specified, Mr. Hammond is to have a call for twelve months at par on 32,875 shares in the new Santa Gertrudis company. No one should begrudge Mr. Hammond this *coup de finance*, nor would anyone be entitled to criticize the big commission, seeing that the directors of the Camp Bird have evidently thought it worth while to make these arrangements, but for the fact that Mr. Hammond occupies the post of consulting engineer to the Camp Bird company. The price of the Santa Gertrudis mine is 9,000,000 pesos, or £922,131, and it is easily possible that Mr. Hammond by his skill as a negotiator may have saved his company £100,000 or more. That is not the point; the point is that Mr. Hammond is consulting engineer to the Camp Bird, and is in the receipt of a handsome retainer. It was his duty to examine the Santa Gertrudis for his client, the Camp Bird company, and it devolved upon him to advise the directors as to the purchase. In a note accompanying the last annual report it is stated that: "On the advice of Mr. John Hays Hammond, the company's consulting engineer, a deposit of £20,500 was made, securing four months' option on the Santa Gertrudis mine, Mexico." That advice was, we believe, excellent and given in the interest of the Camp Bird company, but the payment of the £20,500 to the owners of the Santa Gertrudis rendered it probable that Mr. Hammond and his associates would be paid £119,178 at a later date. According to the last annual report of the Camp Bird, the estimate of ore reserves in the company's old mine in Colorado was made by Mr. F. J. Pope, who was deputed by Mr. Hammond to make the necessary examination. This is, of course, the work that should have been done by the company's consulting engineer. If not, what are the duties of a consulting engineer? Let us say emphatically that we do not impugn the good faith of anybody ; that is not the issue raised. We are quoting the incident to illustrate into what a false position a mining engineer may be placed by participation in mining finance. We venture to say that at least Mr. Hammond should have resigned as consulting engineer before participating as a promoter in the Santa Gertrudis deal ; indeed, we are simple enough to hold that he should, as consulting engineer to the Camp Bird company, have given his services in the Mexican transaction without further recompense, leaving it to his company to bestow a bonus in case of performing exceptional services in an unusually efficient manner.

The episode is a curious commentary on the advisability of the engineer becoming a promoter, for it is obvious that the result of such a change is the metamorphosis of the engineer into the promoter. We are not prepared to say that this is detrimental to the promoter, but we do insist that it is destructive of the engineer, and it is for him that we speak. We quite agree that the promoter will gain by being trained to understand the work of the mining engineer and that mining finance will thereby be rendered more intelligent, as any trade is improved by being placed in the hands of educated men. But the idea that a man can cease to be an engineer and can become a promoter at any moment by mere giving of notice is not in accord with experience. It is assumed that complications can be avoided by stating in each case as it arises whether he is acting as promoter or engineer, but the Camp Bird episode illustrates that this is impracticable, for the directors say that Mr. Hammond advised them to make the first payment on the mine, at a time when, as we now know, his interests were identified with the vendors of the Santa Gertrudis. This is an unusually favourable case because there was no secrecy as between the promoter-engineer and his clients, but who is going to lay down nice rules for a procedure so intricate? Such performances may be managed creditably by men themselves wealthy and with everything to lose by dishonourable dealing. The case is exceptional. Codes of ethics are not made for those who can be a law unto themselves: they are meant to stiffen the moral backbone of the average man, they are a tonic to the weak, and a sign-post to the ignorant. And long experience has proved the value of them. We speak not for the few exceptionally strong men, but for ordinary human nature. To the average man, such participation is dangerous, for it warps his judgment and even undermines his rectitude; in short, financial participation tends to corrupt professional integrity.

Zinc Metallurgy.

The simultaneous invention of metallurgical processes by entirely independent investigators is a recurring phenomenon of psychological and industrial interest. Within the last few weeks we have had cause to note two such coincidences. After referring to Mr. E. J. Horwood's process in our December issue and while we had in our possession Mr. Donald Clark's article, which is published in this issue, we found that a patent covering exactly the same ground had been granted in the United States to H. A. Wentworth, who has assigned it to the Huff Electrostatic Separator Co., of Boston. This patent is numbered 938,732, and is dated November 2. The specification describes how complex sulphides are ground sufficiently fine, and subjected to a roast for a few minutes at a dull red heat. In this way the particles of pyrite and galena are covered with oxide or sulphate, while the blende remains unaffected. Subsequently the mixture is treated by a flotation process, whereby the blende is floated off while the iron and lead compounds sink. With the exception that the respective inventors differ as to the length of time required for the roast, the two processes are identical.

The other subject as to which two inventors concur is also connected with zinc, and relates to the production of a coherent deposit of the metal by electrolysis. The electrolytic production of zinc from solutions has always presented the difficulty that the deposit is spongy and easily re-oxidizes. After this reaction had for many years been classed among the failures of metallurgy, two inventors have independently come forward with methods that appear to afford assurance of success. One has been adopted by Siemens & Halske and the other by the Societa di Pertusola, in Sardinia. As regards the former, a short notice appears on another page of this magazine. Briefly, the basis of the invention is that, if the electrolyte is absolutely free from impurities, zinc can be deposited from a strong acid solution of sulphate in a bright crystalline form free from oxide; and to obtain this condition the inventors use a pure compact lead peroxide as anode. The process at Pertusola is the invention of Eduardo Sanna. By means of pressure and heat combined he produces a compact deposit from a solution of the oxide ore in an alkaline salt. He has found it possible to treat a solution of zinc oxide in caustic soda with a current at 5 volts and obtain a complete precipitation of the zinc without any loss of soda, so that the solvent solution can be used continuously for months. Further details will follow later.

The metallurgy of zinc is thus seen to be progressing rapidly. The separation of slime mixtures of sulphides that are not amenable to water concentration is to be effected by a short roast and subsequent flotation; this process will have an application in mining districts all over the world where complex sulphides have hitherto offered insuperable difficulties to the metallurgist. On the other hand, the successful electrolytic precipitation of zinc from solutions will immediately render available vast deposits of oxidized ores too poor to be treated by distillation.

Wall Street.

The Rock Island scandal, as a recent attempted share-rigging episode is called, has drawn attention once more to the vicious vagaries of the New York stock exchange. In describing the affair, the correspondent of *The Daily Telegraph* cabled that "the sentiment among Stock Exchange members has turned toward punishing the members of the one firm which gave out practically all the Rock Island orders on Monday on both the buying and selling side;" but a little later he adds that "the special committee which is investigating this scandal is not expected to accomplish anything, because the flare up in Rock Island is possible in any other stock, and always will be until the State or the Federal authorities prohibit by law the gambling and manipulative tactics of Wall Street operations." And when the authorities mentioned do succeed in prohibiting such performances they will spoil the biggest game with loaded dice that is played anywhere in the world, a game to which the Monte Carlo tables are but as a Sunday School raffle or a newsboy's pitch and toss. It is a game that absorbs so much of the energies of the most forceful men in America as to represent a pernicious drain upon the constructive force of a great country. Even a superficial observer of Wall Street should be impressed with the number of dynamic men that devote abilities of an unusual kind and capital of unlimited amount to operations that differ from a game of roulette in being not only bigger but also less honest. It is sandbagging in excelsis; it is chicanery on a colossal scale; it is betting without limit. Careful investigation has shown that not less than \$500,000,000 is lost in the Wall Street game in the course of a year, the operating expense of speculative firms reaches \$100,000,000, and the money invested in buildings devoted to exchange purposes in different cities of the United States amounts to \$250,000,000. It was ascertained that the firm of A. O. Brown & Co., which caused a 'flurry' last year, spent $782,000 in expenses during 12 months, in the effort to entrap the unwary and beguile the greedy. Of course, no stock exchange is quite free from queer performances, but the distinctive feature of Wall Street is that it serves as a financial arena for the best brains and the richest men in America, for the type of men that in England are more honourably and more usefully engaged. Wall Street does not represent the mere exchange of securities or the barter of bonds; it permits men to make gambling counters out of railroad systems, to play skittles with entire industries, even to wager the food-supply of a continent. It has the effect of obsessing the American with the idea of acquiring wealth suddenly and enormously, it gilds the statue of Liberty, and dwarfs the Capitol at Washington. Wall Street throws American life out of focus and shrivels the perspective of a nation.

Dredging for Gold

A controversy, now apparently suspended, concerning dredging practice as applied to gold mining, has lately appeared in *The Mining Journal*, and we have been provoked to read it in the hope of abstracting information. And, indeed, sundry interesting facts concerning dredging in New Zealand may be gathered, together with many incorrect inferences as regards dredging in California. The major thesis in the controversy is presented by Mr. W. H. Cutten, a gentleman engaged in the building of dredges, and who in default of an unprejudiced view of the subject must be allowed specific knowledge on some of the matters mentioned. His statements on American, as against New Zealand, dredges are attacked by a commentator who has never seen an American dredge at work. Hence it can be inferred how profitable must be the controversy. If any comparison be more useless than another, it is the cost of dredging in regions far apart. In the very same district the character of the ground may differ so as to make comparisons futile. Even as regards a single dredge, the conditions of operation will vary within wide extremes. Moreover, these academic dissections of working costs as gathered from incomplete statistical data and appertaining to periods not contemporary are more ingenious than informing. We hold no brief either for the Californian or the New Zealand type of dredge; at different periods we have been fairly familiar with both, and are prepared to recognize that each has become adapted to its special purpose as required by diverse circumstances. The aim of dredging is neither to make yardage records, nor minimum working costs, nor maximum bullion returns—not any one alone of these desirable results is the aim of a practical dredge-master, but the best economic result. That involves each of the three factors, but in proper proportion. Rapidity of digging may be attained at the expense of gold extraction; a low working cost may ensue, but it may not be translated into maximum profit. Even big bullion returns may be obtained extravagantly, by wasteful exploitation, selection of the richest ground, and at the penalty, now or later, of an excessive working cost. We need not labour the point. It is obvious that in dredging as in vein mining the truly economic method is the one that yields the largest profit in the shortest time, making allowance for amortization.

In the discussion to which we have referred, it is assumed that the Californian operators are biassed and that they are tied to one particular type of dredge, against reason and against experience. This is a wholly unwarranted inference. The men who are dredging at Oroville, Folsom, and Marysville have spent large sums of money in testing different kinds of machinery, and they are continually on the look-out for better appliances. In the past they borrowed ideas from New Zealand, and they will not disdain to become debtors again. The open-connected type of dredge may have been modeled on a New Zealand design, but it is now deemed no more up-to-date in California than in the place of its origin. After several years of trial, the close-connected bucket-line has been adopted by American operators. And to this type belong the machines in use by the Oroville Dredging company. Mr. Cutten's figures as to this company's operations are all vitiated by the assumption that it had 12 dredges in service during 1907–1908, while the fact is that only 9 were at work on an average during that year. The character of the comparison with the Golden Bed dredge in New Zealand is made manifest by the photograph used as an illustration, which shows the unusually favourable nature of the ground. The scarcity of trees suggests ideal conditions for a head-line and the appearance of the bank indicates ground easier than is normal in California, where hummocks, old diggings, and tree-stumps worry the life of a dredge-master. The Golden Bed dredge would be ill adapted for service at Oroville. Again, a dredge in Burma is said to be working with a head-line *over a mile long:* what ideal conditions must prevail! And 'wash' is mentioned, suggesting loose gravel.

Mr. Cutten quotes the Burma dredges as examples of efficiency but our information indicates that these machines are hardly worthy of being copied. Mr. Lentaigne, the chairman of the Burma Gold Dredging Company, prides himself on his repair-shop, and it is a fact that an experienced English operator has recently gone to California, where he placed an order for a dredge to be used in Burma. This fact is worth a few pages of literary controversy. From this gentleman we learn that the Burma gravel is loose, affording easy digging. The dredges in use have buckets the shape of which, together with the absence of a cutting edge on the lip at the side of the bucket, renders them unsuitable for operation with a spud; hence the employment of a head-line. Moreover, the joining of the buckets by open loose links hinders efficient digging. All this is stated in order to correct erroneous inferences, and for no other purpose, for we would be the first to welcome a fair trial between dredges of British and American manufacture, say, in Colombia, where no difference of import-duty would prevent a test on equal terms.

In California the alluvium is usually cemented to a varying degree. Head-lines have been tried—and discarded—at Oroville. To refer to the Bear River dredge in a discussion of this kind is misleading, for that dredge has been working in ground so difficult—and unprofitable—as to be outside the scope of any intelligent analysis. Although comparatively new this machine required expensive repairs, which raised unduly the average cost of operating the nine dredges of the Oroville company. Similar errors are made in the reference to the Folsom dredges. In the case of No. 4 the close-connected buckets of 13 cubic feet are operated with a head-line, which is suitable in this instance by reason of the easy digging and shallow ground. Costs, under these unusually favourable conditions, are as low as 2 cents per cubic yard, exclusive of bucket-line repairs, which would not be more than ½ cen additional in ground where a capacity is attained of 250,000 cu. yd. per month. This dredge held the Californian record, not Exploration No. 2. On the other hand No. 5, with 8½ cu. ft. buckets, is more expensive in operation, averaging 4·3 cents, simply because the ground is so tough that shafts 70 feet deep to bedrock, and without a stick of timber, have not caved after an interval of 20 years. In such ground it would be impossible for a dredge to do any digging without a spud to hold it firmly in position. And to these notes we may add that the Californian record is now held by the Natoma No. 1, a dredge with close-connected buckets of 13½ cu. ft. capacity, which handled 300,000 cubic yards of gravel in November last, at a cost, including repairs and general expense, of 1·9 cents, or one penny per cubic yard.

Comparison of yardage will convince only the ignorant. In running water estimates are almost worthless. Some remarkable yardages are recorded on the books at Oroville; in one instance over 140,000 cu. yd. was dug in a month by an old boat with 5 cu. ft buckets. When this is done, what of the gold-saving? In general, costs are dependent so largely on methods of book-keeping as to be dangerous guides unless a uniform system be employed —as is not the case. All the experience in California favours the larger and heavier machine, despite Mr. Cutten's lament, and he will find that the fundamental principles of dredging are as fully recognized there as in New Zealand. He has discovered a mare's nest of misleading statistics and has delivered himself of conclusions of which it is only kind to say that they are prejudiced.

Leakage of News.

More than once during the last three months we have heard complaints concerning the premature leakage of information, whereby speculators on the outside have profited at the expense of shareholders. In some cases the blame has been placed upon the management of the mining companies involved and in each instance there has been much dissatisfaction expressed through the medium of the financial columns of the daily Press. The mining companies implicated are usually those operating in distant localities, such as Rhodesia or Mexico. As we hold no brief for either side and desire only to see the business of mining conducted fairly and squarely, we venture to ventilate the subject at this time. In defence of the company officials we ask the public to note that in most cases the London office is helpless to prevent leakage of a certain kind. In South Africa every white man speculates in mining shares, more or less, and being on the spot, or near it, he is able to get news from one or other of the employees at the mine, some of whom are themselves fully awake to the chance of making "a hit on the side." Even when the members of the staff are not so disloyal to their duty as to traffic in secrets that belong to their employer, there will be working miners and others who obtain the earliest intelligence of a 'strike' or a 'discovery' and transmit the news to a confederate. In some cases speculators have been known to maintain an organized gang of spies and reporters, so as to ensure the first news when an important development is pending. Any such information is easily transmitted. The telegraph wires are ready to flash the first whisper; even in localities out of reach of a telegraph station, it is not difficult to imitate the performances of war correspondents and send a messenger on horseback. This has been done often, to the discomfiture of the manager, whose cablegram arrived in London after the event had been fully discounted. People who live in London scarcely appreciate the attention given to the share-market by those who live near the mines, nor have they any conception of the facilities provided for those who take the trouble systematically to anticipate official news. A few London operators on a large scale actually retain agents in the chief mining centres for this sole purpose. Hence the 'leakage.' Of course, the abuse of confidence on the part of the staff or even of the manager, not to mention the directors and secretary, is not unknown, but it is rare. When it does happen, it is amusing to know that the perpetrator is occasionally hoisted by his own petard, buying shares that have already risen on earlier news sent through unofficial channels. But such performances, we repeat, are rare. The errors of the company officials are of a different character, namely, slowness in communicating with their shareholders and clumsiness in the manner of doing so. Not enough trouble is taken to be prompt and not enough care is taken to be explicit. Cablegrams sent from the resident manager to the secretary in London are often so cryptic as to be capable of diverse interpretation; hence they afford no definite information, and can be claimed to cover almost any development sub sequently disclosed. They are oracular rather than obvious in their meaning. This may not be intentional ; it is due largely to the inability of the sender to place himself in the position of the recipient, and is more particularly the product of a supercilious attitude toward shareholders, as much as to say, what business is it of theirs to poke their noses into technical affairs. What is needed is the recognition of the fact that the shareholders are partners to whom full and frank information is due, not as a concession but as a right.

Natal.

As our readers are aware, the Government of Natal engaged Mr. F. H. Hatch as consulting mining engineer to investigate the mineral prospects of that South African State and to prepare a report thereon. The summary of his conclusions has been received with those "mingled feelings" that are always aroused when an unpalatable truth is spoken. Coal, of course, is excepted from the stigma of insignificance. Coal is a great asset to Natal, as gold, so we understand, is to the Transvaal. But Mr. Hatch's report is pessimistic in its references to iron, gold, copper, tin, and graphite, all of which are mineral products previously regarded as offering "good chances" to the enterprising exploiter and providing "illimitable potentialities" to the manufacturers of scrip. When the report is published in full we shall hear vigorous exclamation in the 'garden colony,' and many invidious remarks against the Transvaal. It is not unlikely that the able and honourable mining geologist who has dared to state facts plainly will be represented as an agent of the Transvaal capitalists, anxious to crush the budding industries of Natal lest these jeopardize the financial needs of the Rand. Such remarks have been made before now. We hope that Natal will not imitate Nova Scotia, the Government of which, in 1905, engaged a specialist to investigate the gold-mining resources of the land of Evangeline and then pigeon-holed the report because it failed to boom a Provincial industry. Let Natal accept Mr. Hatch's report in the proper spirit. It is well to puncture delusions, and in the meantime let prospecting proceed, with Government encouragement, until such time as there is more to show. Let not the day of small things be despised or the unpretentious efforts of working miners under-rated, in the hurry to applaud the flamboyant doings of resplendent promoters. Mines are made by digging; and industry is created by work. Natal has resources, but they need to be nursed. Some day perhaps capital will flow south from the Rand just as it has gone north to Rhodesia. Meanwhile the pick is more useful than the pen. Under the able organization of Mr. Charles Gray, Commissioner of Mines, the machinery exists for the inception of further surveys and examinations. The treasurer must grease the wheels. The Natal prospector must work more and talk less.

Tanganyika Concessions.

No British enterprise now in course of development has greater claim upon the interest of technical men than the exploitation of the copper deposits in that part of the Congo Free State lying between Rhodesia and Lake Tanganyika. The amount of money at stake and the technical problems involved are both such as to make the success or failure of this enterprise an event of the first magnitude to all who wish well to the industrial development of Central Africa. And yet the quantity of accurate information given to the shareholders is strangely disproportioned to the importance of the undertaking. The annual report recently issued gives no information concerning the operations at the mines. At the subsequent general meeting the shareholders listened to statements of a most unconvincing character and no one present seems to have asked the two or three questions that must be in the mind of any intelligent observer. To any one with the least experience in copper mining and smelting it is obvious that in the Tanganyika affair there is a danger, to put it mildly, that the economic factor may be severely strained; and to anyone desirous of a successful outcome, it is apparent that no recent enterprise of the first magnitude has been aided so little by adequate technical counsel. Even criticism is disarmed by lack of plain statements concerning the methods to be adopted and the policy to be pursued. It was stated at the meeting that "within three years" the production of copper from the Kambove and Star of the Congo mines is to be "from 60,000 to 90,000 tons of metallic copper per annum," and the output is to be increased by "further development of other mines." Taking even the smaller of these figures, the Tanganyika mines will be producing 150,000,000 pounds per annum. Furthermore, Mr. Robert Williams said that 100,000 tons of copper per annum can be produced for 10 years. This is at a rate equal to the entire Lake Superior region. It is claimed that even these big figures do not exhaust the possibilities, for Mr. Allan Gibb assured the shareholders that they possess "unlimited supplies of high grade and low grade ore," that "the payable ore is practically unlimited," and that it is to be treated by "methods that are absolutely beyond criticism." All of which would be more interesting if it were better substantiated. Similar grandiose statements have been made before by other men to other meetings of other companies, and the public, although it learns slowly, should know by this time that the highly technical operations of a copper mining and smelting enterprise ought to be stated in terms of precision, not in the fervid language of an ecstatic promoter. When ore reserves are said to be "unlimited," the inference is that they have not been measured; and when it is asserted that the ore is to be treated by a process "absolutely beyond criticism," it is safe to suppose that the process is peculiarly susceptible to criticism. On enquiry, we learn that the words in quotation refer to one-third of the ore that is suitable for ordinary blast-furnace smelting, omitting the two-thirds of the tonnage that is to be submitted to a new process, which experienced copper metallurgists would consider anything but "beyond criticism." Such positiveness allied to such indefiniteness is not indicative of the caution to be expected of those who undertake to direct industrial operations of great moment.

For reasons, not obscure, the Tanganyika enterprise has failed as yet to win the confidence of technical men. It is recognised that enthusiasm in mining is often wasted for want of the discipline of specialized knowledge. Moreover, the Tanganyika affair suffers from bipartite management, the control of these copper mines in the Congo Free State being in the hands of the Belgians, who own 55% of the shares in the name of the Union Minière Du Haut-Katanga. The other 45% is controlled by Englishmen, led by that energetic promoter, Mr. Robert Williams. As the ownership is nearly equally divided, the control lies between the two interests, the Belgians directing the administration and the British the technical management. Such division of authority usually provokes friction, and even when harmonious is prejudicial to efficiency. Mr. E. Halewyck represents the Belgians and Mr. Allan Gibb is chief engineer for Robert Williams & Co., who are designated consulting engineers to the Union Minière. The capital is £1,000,000 in an equal number of shares, of which 758,094 have been issued and are now quoted at £5¾. In addition £2,600,000 in 5% debentures has been issued, so that a total investment of £7,000,000 is at stake.

An immense deposit of copper, as a carbonate in shale and sandstone, and also in dolomite, has been exposed, preparatory to smelting. This ore contains 10% copper and 60% silica. It is expected to have 8 to 9% copper on the charge, and to obtain a slag containing ½ to

1% copper, the aim being to make a slag low in iron, using a lime-alumina silicate. It has been assumed by those in control that a large copper-smelting plant can be erected in the heart of Africa at an original cost of £45,000 per unit of 1000 tons per day. The estimate has been raised from time to time and is now £100,000, this increase in itself being sufficient commentary on the nature of the information upon which the original figures were based. We may state that the cost of such plants as the Anaconda, Garfield, and Steptoe—three of the largest and most successful of modern copper smelters—averaged £260 per ton, or £260,000 per unit of 1000 tons, and there is reason to believe that the Tanganyika plant will cost, from first to last, from £300,000 to £350,000 per 1000 tons of capacity. This refers, of course, to a plant completed on a profit-earning basis, after rectification of all preliminary errors. We believe that the management is also over-sanguine as regards other estimates of cost, for while a rate of £1 per man per month in the Congo may look like cheap labour, it is not economical if put on the basis of tonnage. We doubt if it is less expensive per unit of work accomplished than the $1·75 per day paid to the common labourer in Western America. This is important in making comparisons between various outlays for plant and equipment.

The technical problem is interesting, namely, to beneficiate silicious oxidized copper ore in a locality where no sulphide ore is available, where suitable fuel is scant, where skilled labour is expensive, and supplies have to be imported from remote markets. The official analysis of the ore shows 12 to 15% copper, 45 to 60% silica, 4 to 12% alumina, 2½ to 4% ferrous oxide, 2 to 8% lime and magnesia. How should such an ore in such a locality be treated? It is not for us to say; it is obviously a question to be answered best by a metallurgist who has faced successfully similar problems elsewhere; assuredly it is no matter to be settled by an academic discussion such as formed the basis of the report upon which the choice of methods was finally made. Leaching, direct smelting, wet concentration, electric smelting, and other impracticable schemes, were gravely considered before an ingenious, interesting, and wholly experimental process was finally selected. The process may be briefly outlined: The ore is separated into two classes. The high-grade stuff, which is hand-sorted, represents about one third of the tonnage and will be smelted in a blast-furnace. The bulk of the output is a low-grade silicious ore, which will first be crushed and screened. This oxidized product is mixed with charcoal and is then reduced to metallic copper in roasting-furnaces, the aim being to make a sinter, which is withdrawn from the furnace and then quenched in water, to prevent re-oxidation of the copper. The sintered product, containing the copper in metallic condition, is crushed under rolls of large capacity. By water-concentration the shot copper is then separated from the gangue on jigs and tables, after the model of Lake Superior practice. The resultant concentrate, containing 70% metallic copper, is melted in a reverberatory furnace, and is afterward refined in a smaller furnace of the same kind.

The estimated cost is three shillings per ton for preliminary crushing and screening; roasting is to be done for 3s. 2d. per ton; and treatment of the sinter for 1s. 4d. per ton. Comment is superfluous. The broad assumption is that Lake Superior costs can be bettered; even the refining is to be done cheaper than in an old well-established mining region, near large manufacturing centres and in localities where skilled labour is plentiful and relatively cheap. No general expense is quoted, only the working cost. But in the case of an enterprise such as this the administration, general expense, engineers' salaries, maintenance of offices at London and Brussels, together with incidentals, will amount to a pretty figure. The

Katanga mines will eventually be connected by the Benguella railway with Lobito Bay, which is on the west coast and 1050 miles distant; they will also be connected, probably in June this year, with the Rhodesian railway system to Beira, on the east coast and 1700 miles distant. At present the freight-rate is one penny per ton mile, but it is estimated that the cost of transport from the mines to London will be £8 per ton. Coke is to be obtained from Wankie, in Rhodesia. The Tanganyika Concessions is to spend £100,000 on a coking plant, and the result is to be the delivery of coke, containing 14% ash, at a price of £5 per ton.

The roasting-furnaces are to be fired by gas from wood-fuel. There is to be no fine copper to give rise to losses, such as occur at Calumet. The analyses of slag made in the experiments include no copper, and it is claimed that the loss on a working scale will be much below 1%. Finally, copper is to be delivered at London from Central Africa for £25 per ton or 6 cents per pound!

We have avoided needlessly severe criticism. Those who understand the metallurgy of copper will be able to form their own conclusions. But technical points will be unappreciated by the general public and by that part of it which has become a partner with Mr. Williams and his Belgian friends in the Tanganyika enterprise. It is obvious that an undertaking involving so much money and bristling with so many technical difficulties requires the most expert advice; in short, the most experienced copper metallurgist alive ought to be engaged, not to replace but to aid the gentleman now in charge of the smelting department. It is true that a capable metallurgist, Mr. Walter G. Perkins, was recently engaged, on the recommendation of Mr. E. P. Mathewson, of Anaconda, to supplement the staff at Katanga, but we are informed that Mr. Perkins disagreed so radically with the policy adopted and formed opinions so unfavourable as to the results likely to ensue, that he has already terminated his engagement with the company. In this connection, it is proper to ask what was Mr. R. J. Frecheville's opinion of the Tanganyika; he made an examination and report in 1907. Did his clients become shareholders? No other report on this enormous enterprise has ever been made at all equal in weight to that of Mr. Frecheville.

Finally, it is fitting to draw attention to some observations made by Mr. James Douglas in his paper on the 'Conservation of Natural Resources,' read before the American Institute of Mining Engineers a year ago. He referred to the loss of copper in slag, and turned to the early metallurgical operations at Bisbee and Globe, two districts where silicious oxidized copper ores were smelted under conditions comparable to Tanganyika. The ore of the Copper Queen contained about 10% copper, and the slags were formerly claimed to assay less than 1%; yet those very slags are now being re-smelted and are found to carry 2½%. At Globe the output was even more silicious, so that the average charge was diluted with 40 to 50% limestone. The ore averaged about 12% copper and the charge from 7 to 8%. The slag was supposed to contain ½% copper; it is now being re-smelted and yields 3½%. Thus the losses at Bisbee and Globe ranged from 16 to 32% of the copper fed to the furnaces. At Morenci the loss was even greater, as much as 40%, for the old slags contain 4½% copper, but in that locality they thought themselves clever in finding a means of washing their granulated slag into the river, having assured themselves that it was so free from copper as not to be worth saving! By quoting these facts, presented by an authority of the highest standing, we do not mean to suggest that the metallurgy of copper has stood still and that the experience of the last twenty-five years has been wasted; of course, more is known on the subject than in the early days of the Arizona copper industry, but we are not aware that such knowledge is being frankly and generously applied to the Tanganyika problem. For that we criticize Mr. Robert Williams, Mr. Allan Gibb, and the directorate of the Union Minière du Haut-Katanga.

Cyanidation.

The highly technical articles on the 'Measurement of Pulp and Tailing' by Mr. W. J. Sharwood will have delighted those who understand the details of cyanidation and more especially those who appreciate the fact that the practical operations of the mill are based upon physical constants and scientific principles. By his modification of the units employed by cyaniders and by his mathematical analysis of common-sense operations, Mr. Sharwood performs a distinct service for that large body of men whose symbol is KCy. In these thoughtful studies upon the subject he embodies the work done by Mr. C. W. Merrill and himself at the Homestake mine, and thereby affords a stimulus to intelligent operation in multitudinous localities where gold and silver are extracted on a large scale by means of cyanide solutions. It is probable that the formidable appearance of some of the equations may intimidate a few of our readers, but they are simpler than they look, and merely express in a succinct manner relations that may not be recognized in every-day practice by that most practical person the muscular millman, but are nevertheless the scientific basis of his unscientific labours. To those academically inclined and eager to express technical processes in terms of precision, the formulas will be glimpses of the obvious, illuminating the routine work of the cyanide annex. The growth of leaching processes has led to the introduction of new units and fresh terms, the unsystematic use of which has caused confusion. Comparison between districts, or even between mills in the same district, is vitiated by the employment of undefined units, so that much of the literature of the subject is endangered as regards intelligibility and trustworthiness. Hence the value of conversion tables and the clear description of methods of measurement applicable to diverse conditions. Mr. W. A. Caldecott has tried to inculcate accuracy, as by defining the unit known as the 'fluid ton,' but it remains true that on the Rand even to this day the discrepancies in methods of measurement go far to nullify the value of reports. The question of tonnage is answered by a sloppy empiricism, the percentage of extraction being based largely upon an approximation from the gold recovered and assays founded upon inaccurate measurement of ore. We feel assured that the conscientious efforts of Mr. Sharwood to crystallize the amorphous methods of the cyanider will be cordially appreciated, and the Editor is encouraged in this hope by the fact that he found Mr. Sharwood's manuscript so well prepared as to require scarcely any revision. Accurate writing and lucid exposition are trustworthy signs of the precipitation of thought from mental solutions filtered by earnest purpose.

Sampling of Ore.

The prospectus of the Bembesi Goldfields of Rhodesia affords an instructive example of incorrect inferences from the results of sampling the ore in a mine. Most of the errors so glaringly manifest will have been detected by those who are experienced in such matters, but for the sake of the untechnical public it will be worth while to analyse them, in the hope of conveying a useful lesson. In the first place, only 11 assays are quoted, representing as many samples. None of the samples, even those yielding abnormal returns, appears to have been re-assayed. Yet we are told that there is proof of "the existence of a payable lode, which has a strike of fully 800 ft. with an average width of 4 ft." This may mean, but does not state, that the orebody is 800 ft. long; and it will be inferred to be so by those to whom the prospectus was sent. 'Strike' is a term meaning the trend as expressed by the points of the compass. However, assuming the most probable meaning, namely, a run of ore extending for 800 ft., then it should be obvious that 11 samples are wholly inadequate to test its average value. A body of gold-bearing ore 800 ft. long should be tested by samples taken at every 10 feet, so that 80 samples is the minimum on which to base a serious estimate. Next we note that of these 11 samples, the lowest contains 1·3 dwt. per ton, while the highest assays 107 dwt.; and the widths recorded range from 2 ft. to 7 ft. The average is given as 18·8 dwt. per ton. The average obtained by adding all the assays and dividing the total by 11, is indeed 18·7, but this is incorrect, because the method disregards the variations in width. For example, the seventh sample is taken at a spot where the ore is 7 ft. wide and assays 4½ dwt., while the high assay of 107 dwt. is obtained from a width of only 2 ft.; that is, there is 3½ times as much of the poor as of the rich stuff. This fact is disregarded; in short, the method of averaging neglects the quantitative factor. If we now take the real average, multiplying the widths into the assays, adding the products, and then divide the total of these by the total number of feet, we get 15·9 dwt. as an approximately correct average. But even this is open to criticism, for it includes at least two assays so much higher than all the others as to invite the belief that they are aberrant, that is, represent exceptional spots of specimen ore, not likely to be confirmed by stoping operations. Omitting these two high assays, the average becomes 7·6 dwt. But this may err too much the other way, so we replace the two exceptional returns by assays equal to the best two of the other 10 samples, and finally get an average of 9·3 dwt. as the probable average. This is exactly one half of the figure stated in the prospectus.

But even this result would not be acceptable to a careful engineer, because the number of samples is wholly inadequate and the assays vary within limits so great as to render any average at best only a guess. Moreover, it is open to doubt whether the samples were broken at equal intervals apart; if not, no average can be struck. The description attached to each sample suggests 'grab' sampling, which is a snare and a delusion, long since relegated to the limbo of discarded methods. Such evidence as the prospectus affords, goes to indicate that the assays do not represent true samples, for it is stated that the 'reef' is 40 ft. thick at two places where the ore was broken for a width of only 4 ft., without any information as regards the contents of the other 36 ft. Five of these samples were taken in ore less than 4 ft. wide and only one was more than 4 ft., which is given as "the average width." In short, the evidence, on the face of it, is not trustworthy. The mine may be all that the promoters say, but the prospectus does not give adequate testimony.

It is well to point out that no true average can be obtained from irregular or unsystematic sampling. Nice calculations cannot be based upon coarse work. Logical methods must be applied as much to the moil and hammer as to the pencil and paper in the office. Finally, the function of a sample is not merely to represent the richness of the ore at the spot sampled, but the yield to be won from the cubic contents of a slice of the lode measured by the width sampled, the interval between samples, and the height to the next level, so that if the sampling is done at 10 ft. intervals in a 4 ft. lode between levels 100 ft. apart, then each assay stands not for a few pounds of ore in a sack but for 275 tons of ore, from which it is expected in the mill to extract as much gold as is recorded upon the assay-sheet. Sampling is not child's play and it is not an academic performance intended to decorate a prospectus; that of the Bembesi Goldfields of Rhodesia illustrates how this important work ought *not* to be done.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

TIENTSIN.

Railway Concessions.—The question of the foreign loan for the construction of railroads in southern China furnished foreign diplomats and foreign journalists with much material for their activities during the past summer, and, if one can trust the newspapers, they have it all settled to their satisfaction at last. But, unfortunately for their happiness, it now turns out that there are two serious obstacles in the way of entertaining a belief that the difficulty is really settled. In the first place, the British Pioneer Corporation has lifted up its voice and called attention to the fact that, ten years ago, it secured a concession to work mines at Ssu-chuan that carried with it the right to build railroads to connect them with trade-routes. Of course it never did build any railroad, and I suppose it would scarcely claim the exclusive right to do so in that part of the world, but it enters into the case as a disturbing factor, nevertheless. One can readily understand the sense of injury and irritation that was so discernible in the recent Imperial edict announcing that all the old concessions granted years ago contingent upon actual construction and operation have automatically lapsed by the non-performance of the work, and no attention will be paid to them. One can equally well recognize its futility, for, as soon as the diplomatic jack-screws are put on, the Government will immediately find that the poor concessionaires ought to be compensated, after all. But the really serious factor is that the people of the provinces interested have announced that they will never allow the loans to be consummated. Now, anyone who knows China understands that the Government neither now nor at any other time has been able to force any action in defiance of the popular will. And as the reports from these districts indicate that the people are really determined that the loan shall not be incurred, it seems extremely likely that it will not. The construction of the railroads will be delayed indefinitely, and as the French are steadily pushing their line from the Tonkin border into the heart of Yun-nan, it begins to look very much as if the trade and mineral development of western China will fall under French influence, instead of the British influence that was steadily extending itself up the Yangtze. But the French are meeting with much hostility and opposition, so that their path also is not strewn with roses.

Oil.—The production of petroleum is attracting much interest in the East. The Japanese would like to find a steady supply of crude for the refineries which they erected with such buoyant optimism before the actual resources of their fields were known, and the Chinese are also beginning to think that they would like to produce some of their oil instead

Administration Building, at Tientsin, of the Chinese Engineering & Mining Co.

of buying it all abroad. In an earlier letter I spoke of the company that has been organized to exploit oil in Saghalien, and I must now mention the company organized with Chinese capital to exploit oil in Shensi, near the town of Yen-chang. Some Chinese students who have returned from Japan have charge of the work and I believe some wells have been drilled, but the only information concerning results seems to consist of vague rumours Not long ago the local paper published a Berlin despatch saying that petroleum has been discovered in the southern part of Chi-li, evidently supposing that it referred to the province of that name. However, Chi-li province is not so unlikely a place for the discovery of petroleum as might at first be supposed, for, although the larger part of its area is covered with the loess, yet the carboniferous strata dip under the plain from both the north and west, and must closely underlie it in many places. The geological structure is thus favourable, but we are faced with the discouraging fact that no oil has yet been detected in the strata. The oil-wells of Ssu-chuan are well known and the occurrences recorded in Shensi and Kansu are interesting, at least.

Mining Bureau.—The central government is displaying not a little interest in the mining industry. The board which has charge of mining matters has issued a report, but, although I have been promised a copy, I have not seen it yet. Probably, it will be, as Pere Coldre remarked of another Chinese book, *rempli d'inutilités et d'inexactitudes.* The organization of the provincial bureaus is making fair progress. In Chi-li and Manchuria these matters are looked after by men who have studied abroad, and the provincial geologist in Ssu-chuan is a graduate in mining from the University of California. The latest to be appointed is the director of mining affairs for Kuangtung, C. Y. Wang, who has studied both at California and Columbia Universities, and who has written extensively on the metallurgy of antimony. Apparently a new era in appointments has begun. Formerly it was the custom to appoint a student who had graduated in medicine in Germany to direct a railroad company, a student returned from the naval schools of England as principal of a school, and so on. But with a policy of appointing men to the work for which they are best fitted, it seems as though material advance in the development of the resources of the Empire can reasonably be expected.

MELBOURNE.

The strike at Newcastle drags along. It is a wanton demonstration on the part of the labour leaders at Newcastle against the industrial world of Australasia. This is possible because Newcastle has the only large coalfield in this part of the world. The first move of the men was to strike ; the next to submit a long list of grievances. Then followed a proposal for a conference with the owners, who, of course, wanted the situation restored: "Take up your positions in the mines and we will go into conference. If we cannot agree then we will refer the matter to the Industrial Court for settlement," said they. The men returned a decided negative. Then the strong man of the state, C. G. Wade, the Premier of New South Wales, appeared. He suggested that the men should go to work the day the conference met. Although in such a state of ill-health that his medical advisers declined to accept the responsibility of his action, Mr. Wade agreed to meet the men and persuade them to accept his proposal. The owners, after deliberation, accepted it. By doing so they threw upon the miners the onus of declining a conference and of flouting mediation. Badly led by their firebrand leaders, the lodges gave a refusal to the Premier, and, seeing that public opinion was regarding their grievances as frivolous, they formulated a fresh statement.

Of the six grievances of the northern miners, two may be settled locally by the local lodges, leaving four to be brought before the northern open conference, should it be held. The question of fixing a minimum wage for all classes of labour would mean an alignment with the Broken Hill district. As the whole of the coal trade is based upon the contract system it is most likely the owners will accept such a proposal. They have to face the world's market for at least one third of their output and they cannot have men working without a personal inducement to do their best such as exists under the contract system. As to the price to be paid for small coal, there seems to be reason for a concession. Small coal is now a good market commodity, and as it forms a not unimportant portion of the output of the miner, he ought to receive a proper return for breaking it. At the same time the return has to be such as to induce him not to be careless in his work. The actual cost of such concessions to the miners has not been investigated and therefore cannot be stated ; but they will eat into profits, and that involves a fight.

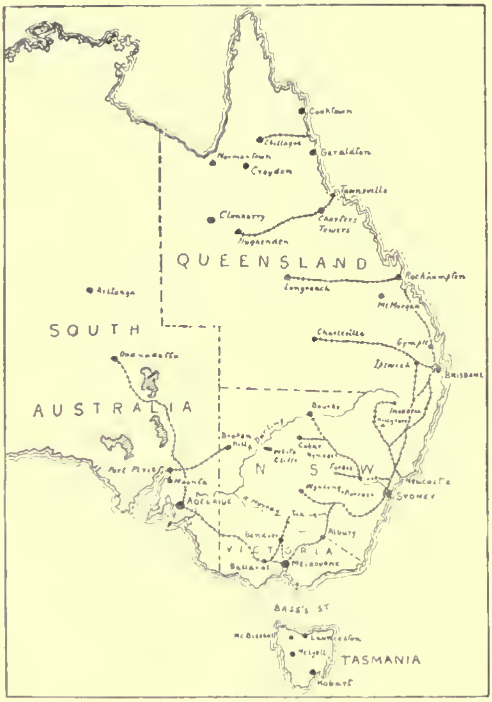
Industrial paralysis. — The most noteworthy feature is the indifference of the Newcastle miners to the welfare of the community. As I write, train services are being curtailed, steamers laid up, factories shut down, the cost of food increased, freights and fares raised, wool shipments are being blocked, and supplies to farmers for harvesting are jeopardized. So callous a display must weaken cohesion among unionists. The men are trying to perfect a scheme for working some of the pits, but they will have to find the means of transport as well as provide facilities for distribution. Moreover, the supply forthcoming would be insignificant. At present the outlook in Australia is most depressing, although we have a magnificent wool clip, fine prices, and a record harvest.

Of course a fillip is being given to the idea of State coal-mining. But by the irony of fate the New Zealand miners have demanded more wages, flung down their tools in defiance of the State, and now threaten to paralyse the trade and railway service of the country. This situation has to be explained and labour leaders are in difficulty to find excuses. They are, of course, preaching the cause of the men both here and in New Zealand. But the ordinary citizen who is inconvenienced is beginning to see that there is a risk in placing the community in the hands of labour, as would be the case if State coal mines were made the sole source of fuel-supply for our railways.

Mt. Lyell.—The directors of the Mount Lyell Mining & Railway Co. presented a capital report at the half-yearly meeting. The net profit was £139,850, which compares with £126,158 for the preceding half-year. When it is remembered that the management works down to about a 2·3% copper, the results can be appreciated. Without going into detail it can be affirmed that the property never was in a better financial position. The directors are fortunate in having as their right-hand man Mr. Robert Sticht, and as their secretary, Mr. Arthur Mellor, an organizer of great capacity. The consequence is that the business of the company has never been allowed to flag. The turning point was the acquisition of the North Lyell mine. Then came the superphosphate and sulphuric acid business. This now extends to South Australia and Western Australia, and will in time reach New South Wales and Queensland. To meet the requirements of their business the company has taken up the Chester mine near Zeehan, where diamond-drilling has demonstrated that an exceedingly large deposit of iron pyrite exists. Prospecting parties also have been sent into Norfolk ranges near the Mount Balfour copper district, and most encouraging prospects have been obtained on some of the blocks acquired. The advantage of having active officials and a board in touch with Australian mining is shown by the broad way in which the affairs of the company are managed. English capital holds the bulk of the shares in the company, but that fact in no way interferes with the assiduity or the enthusiasm of the staff.

Dredging in Siam.—One of the peculiarities of Australian mining men just now is to turn down mines near at home to take up those in distant climes. Among the most popular is the Tongkah Harbour Tin Mines, promoted originally in Tasmania and now largely held in Australia. The property is in Siam. Three bucket-dredges from Europe have been started, but the work done by them has been most erratic, owing perhaps to faulty construction, perhaps to divided management, perhaps to lack of knowledge of the ways of dredges. There has been a good deal of rumoured nibbling on the part of European capitalists to invest £50,000 or £100,000 in the claim because of its reputed richness. Somehow these offers do not mature. In the meantime the company is finding, what with stoppages of plant and other obstacles, that it is not making rapid headway. The ground appears to be yielding fairly well, but more dredges are wanted, and more capital to hustle things along. The attention given to the Tongkah Harbour has induced the sending of half a dozen mining men to pick up tin claims in Siam or Burma.

Deep Leads.—The shutting down of the



Eastern Australia.

Prentice & Southern mine at Rutherglen marks the retreat from another Victorian deep-lead property by Bewick, Moreing & Co. The mine had heavy water to face, with consequent burdensome pumping charges. A great deal of development work was done by the firm in the way of working back to the boundary with the intention of stoping thence to the shaft. The machinery, however, would not stand the pressure at which it had to be worked. A serious breakage occurred; the result was that the Government was given the option voluntarily to help the company or let it be closed down. It is understood that the directors did not put this phase of the situation to them. That was done informally by a friend of the district. As the State has put £27,000 into the mine it would go no further, so the result is a cessation of all operations. Bewick, Moreing & Co. now have only the Berry United at Creswick of all the deep-lead options that they took in hand. The wash averages fairly well, but the expenses are heavy, water still being the trouble, and so profits are not being made. Now the news is to hand that the Loddon Deep Leads near Clunes is being abandoned. This adds to the record of British failures in Victorian mining. The fault lies with those who predicted that the leads contained rich wash, whereas the contrary has been proved to be the case.

The report on the De Bavay process by Messrs. Bewick, Moreing & Co. as written by Mr. B. P. Mitchell, their general manager in the eastern states of the Commonwealth, for the Amalgamated Zinc (De Bavay's) flotation is a masterly document. While it is convincing as to the recoveries and profits that can be achieved with zinc at £21, £22, or £23 per ton, it lets the uninitiated guess at other probabilities. The most important of these is that the output of zinc concentrate from the Broken Hill mines will shortly assume such a size that, Zinc Convention or no Zinc Convention, the market may not be enabled to sustain the weight of the load. News has reached Australia that some of the old world mines are being shut down for the reason that the profits the European smelter can make from Broken Hill zinc concentrate are such that it pays him to keep other mines closed although he may be able to get cheaper zinc ore from them. Whether this be so or not some of the labour party and the protectionists do not like to see raw products such as lead and zinc concentrate sent out of the country as raw material. They are inclined to advocate an export duty, such as was adopted in the Malay to prevent the export of tin ore and foster local smelting. The foreign ore buyers have sought to safeguard themselves in the matter when drafting their contracts, but the state socialists on this side of the world have a precedent which they could follow to beat this device. In land tax legislation any attempt to pass on or contract out of the tax is guarded against. It would be equally easy for Parliament to insert a provision of that kind in respect to zinc concentrate if it really made up its mind that the export duty should be imposed. A great deal will depend upon the success the Broken Hill Proprietary Co. may achieve with its zinc plant. This is being erected at Port Pirie. Some metallurgists here predict a costly failure. But the company does not, as a rule, work blind-folded and it may be able to set criticism at naught.

DENVER.

Petroleum is attracting attention at a number of points. In California, Oklahoma, and Illinois, the big producing States, production and development have been steady and enormous. In California prices have remained good and contracts for the future are being based on $1 per bbl. or better. The new arrangements between the Union company and the independents put the latter in the best position they ever have occupied and the year closes with a good record in production, dividends, and development of new territory. There has recently been some talk in San Francisco of American investments in oil lands in the Philippine islands. Petroleum is known to occur at a number of points on the Island of Cebu and in the Tayabas province of Luzon. George I. Adams of the Bureau of Mines has reported favourably on certain fields in Luzon accessible by automobile from Manila, and efforts are being made to interest local capitalists in their exploitation. The oil is exceptionally high-grade and aside from the Philippine and Eastern market, would be in demand on the Pacific Coast of the United States. California oils do not yield enough of the lighter distillates to supply the local market and importations from Java are regularly made. For these reasons California operators are favourably impressed with the matter and if lands can be obtained on suitable terms some of them will probably undertake drilling. In Oklahoma and Illinois the production has been large but prices have been unfavourable. The new pipeline of the Prairie Gas & Oil Co. (Standard) from the Oklahoma fields to the Gulf will relieve the congestion in the Mid-Continental field in part only. In Illinois prices have dropped from 60 and 68c. to 52 and 60c. per bbl. No new fields have been found though the new ones have been materially expanded. In Colorado the De Beque field in Mesa county is attracting 'wild-catters.' This field was reported on favourably by the geologists of the U.S. Survey some weeks ago and many leases have been taken. Two wells are now being put down. Colorado is not a large producer of oil, but is noted rather for the high grade of its product and the good prices obtained. In 1908, 379,653 bbl. were produced. Of this 295,479 were from the Florence field and the remainder came from near Boulder. In 1909 the output was probably a little large, Boulder having made some gains.

Coal. — Colorado is much interested in the reputed purpose of the Federal authorities to bring suit against the State and also against the American Smelting & Refining Co. for recovery of coal-lands said to have been taken under false pretences. There seems to be some question whether, granted that the facts would sustain such suits, the statute of limitations would not act as a bar to the recovery of the lands. In that event it is said to be the purpose of the Attorney General at Washington to bring suit for recovery of damages on the basis of a reasonable royalty for coal extracted from the ground. If such damages can be recovered the effect will be far-reaching, since it is an open secret that many of the great private holdings of coal-lands in the West have been obtained by processes that at least technically violated the law. Records on file with the Bureau of Corporations show that 2000 acres of land valued at $200,000 and situated in Reilly canyon are owned "by or in the interest of the" A. S. & R. Co. Mines on the land are operated by the Carbon Coal & Coke Co. and 250,000 tons of coal has been extracted. Title to these lands has been under investigation for some time, and it is now reported that dummy entrymen were used in securing them. Suit for $3,000,000 damages is threatened. It will be remembered that a similar action against the Union Pacific relating to coal-lands in Wyoming, resulted in the recovery of considerable land and damages on a royalty basis for coal extracted. The suit against the State of Colorado is of a somewhat different character. When that State was admitted to the Union in 1876, the General Government had large holdings of land within its borders. A certain number of square miles was ceded to the new State to be sold, the proceeds to be used to endow the public schools and a university. It was one condition of the transaction that the State officials were not to select mineral-bearing land and that if any such land was inadvertently included, it was to be exchanged for other land which should be non-mineral bearing. Despite these precautions Colorado now possesses considerable acreages of mineral land and draws a substantial revenue from royalties on the minerals mined on them.

General Activity. Mining in Colorado is about as active as usual. The coal mines are doing well, and just by way of emphasizing the fact and evening up for the recent lean years, have added 50c. per ton to the price of coal. The general public fails to see the philosophy of this and is protesting vigorously. The old placers near Idaho Springs have taken a new lease of life and 50 men are at work near the Stanley mine. At Cripple Creek production in November amounted to 59,215 tons valued at $1,284,487. The Golden Cycle mill handled the largest part of the output, 25,380 tons worth $517,742, with the U.S.S. & R. Co. and the smelters close together for second place as regards value. The Portland mill crushed 9000 tons worth $171,000. The

A part of Colorado.

drainage tunnel is now nearly 1000 ft. into the granite of Beacon hill and troublesome water-courses may be cut any day. The Burleigh tunnel at Georgetown has at last been connected with the old Seven-Thirty workings. It will be remembered that the Phillips raise failed to drain the Seven-Thirty as promptly as was anticipated and there was at one time fear of a disastrous flood from suddenly breaking into the old workings. By pilot-holes the water was finally tapped and now that the lower workings are accessible it is found that the Seven-Thirty shaft had been filled some distance by lessees in the upper workings, who found it a convenient place to stow waste.

JOHANNESBURG.

Metallurgical Matters.—The November meeting of the Chemical, Metallurgical, and Mining Society made a record in point of attendance and almost a record in the importance of its agenda. There were 130 members and visitors present, including six past-presidents, besides F. W. Harbord, F. L. Bosqui, and many other distinguished metallurgists. It was essentially a metallurgical meeting. G. H. Stanley discussed, from the laboratory standpoint, the possibilities of utilizing our great deposits of titaniferous iron ore; A. F. Crosse described his new method of slime-treatment in a conical vat with a cone-shaped baffle, inducing circulation; F. Alexander stated how he had successfully applied this Crosse process to the treatment of battery 'black sands' at the Crown mines; G. O. Smart gave the results of his experiments as to the influence of different intervals of time between the dressings of the tube-mill shaking-tables, concluding in favour of eight hours as the longest interval advisable; W. G. Urquhart suggested the use of a 7-jet mortar-box water service instead of 5, the two extra jets being used to wash round the sides where most banking takes place.

Statistics.—The appeal made by L. Reyersbach for the abolition of the detailed monthly output declarations of the Chamber of Mines has no doubt already been discussed in London. The following may be considered a Johannesburg point of view. While the majority were unreservedly astonished by Mr. Reyersbach's proposal, they are infinitely more astounded by the opinion expressed by Barnato Brothers in London—that the idea is "preposterous." The righteous indignation suggested by this condemnation provides an amusing factor in the discussion that has fully compensated for the mental wear and tear involved in weighing the host of arguments to be arrayed on both sides of the controversy. Let it be said frankly that while Mr. Reyersbach's idea may grow in favour, it is at present supported only by a small minority. The advantages appear to be too shadowy; the drawbacks and dangers are too manifest. Although the monthly statistics are so comprehensive, the work involved in their compilation is a negligible quantity. The data provided would be worked out by the mine secretaries in any case, if only for the use of the manager and directors, who will be none the less anxious to keep in touch with results. The question of saving labour is, indeed, an insignificant factor. It is in the influences of the publicity afforded to grade, costs, and profits every month that we must turn for guidance. Mr. Reyersbach's strong point is that the demand for equalization of grade prompted by the close comparison of results for such short periods, has a bad effect on policy and forces the managers to distribute their workings widely in order that the law of averages may bring the grade to about the same figure every month. If only an annual declaration is made, the most economical system of working—which may be concentration in a richer or poorer part of the mine—would alone be considered. What are the arguments opposed to this annual declaration? A few summarized are:

(1). The faith of the multitude of small investors will be shaken, for while they are more in the dark they will suspect that influential shareholders will be able to keep acquainted with the trend of operations.

(2). In view of the extreme ignorance of a large part of the investing public and the impossibility of educating them, it is strongly advisable to maintain the grade at the figure justified by the ore reserves. A drop of 10s. per ton in yield, due to a scheme of more economical working and to the benefits of the principle of exhausting the richer ore first, would create distrust.

(3). There would actually be but a slight change of method underground, for managers have lately (especially in the large mines) let the grade look after itself, while aiming primarily at the reduction of working costs.

(4). The long period between the declaration of yields would put a premium on secret-service information and would lead to the dissemination of numberless rumours. Head-offices would be kept so busy contradicting reports, "baseless, unwarranted, and without foundation" that the labour involved in correcting false information would be tenfold that now engaged each month in compiling an analysis of the absolute facts.

(5). If a mine has trouble, with dropping tonnage and grade, it is better to let shareholders know this by regular declarations than that they should find it out for themselves through back-doors.

The whole question is one of degree. While annual declarations would undoubtedly lead to great abuses and even place the Rand behind its old-time rival, Kalgoorlie (once scorned for its methods of secrecy and misrepresentation), the introduction of detailed quarterly analyses could be considered if the technical influences of the present system are proved to be unsound. But even in the period of three months, there is plenty of time for Dame Rumour to get busy, especially in a place where her mischief-making propensities have been so effectively suppressed by the policy of drowning her curiosity in a torrent of statistics.

French Rand.—The decision of the Board to close down, though anything but surprising to those conversant with the mine's increasing poverty in gold and richness in faults, has nevertheless come as a shock to many who hoped that money would be found for further operations—in development, if nothing else. The floods of February last, followed by labour shortage, checked the possibility of profitable production in a mine that could only have made bare profits under the most favourable conditions, with its backward development. Judging by all official reports and records, a policy was being pursued, on sound lines, of opening up the practically unexplored western deep-level area and had already been carried to an advanced stage. With the suspension of milling this good work has been largely wasted, though it certainly leaves the mine in a more attractive position when the time arrives for re-opening. One thing appears certain: that it would be a poor speculation to resume until there is an adequate supply of hand-labour to enable further development to be followed by stoping on principles suited to the narrow width of reef characteristic of this mine.

Association of Engineers.—The South African Association of Engineers has been grievously imposed upon. Considering the high standard it has gained through the excellence of its transactions and the encouragement it has always held out to the younger generation of engineers to bring forward their ideas, it is extremely regrettable that the privileges of the Society should have been abused as at the last meeting. It was announced in the Press that K. Leinberger (an old Freiberg student) would read an "original" paper on the "Sand-filling process or waterborne packing of stopes." The paper was read, and, with the only apparent flaw that considerations of cost were omitted and that the possibilities of applying the system to the Rand more widely were not discussed, was a useful and accurate account of German experience. Interesting

WITWATERSRAND DEEP MINE, JOHANNESBURG.

discussion followed, in which the Robinson sand-filling method was mentioned and the advantages of the process on the Rand briefly suggested. Soon after the meeting—which was reported with further acclamation in the daily and technical Press—it was discovered that Mr. Leinberger's paper was nothing more or less than an abstract of Otto Putz's treatise entitled 'Das Spulversatzverfahren.' Fifty per cent of the 'original' paper was literal translation and 50% was condensation, with three lines of new matter referring to the well known fact that there have been subsidences of ground at the Bonanza, Champ d'Or, and elsewhere along the Rand. It need hardly be said that the Association, upon learning the true position, has done all in its power to set things right. The proceedings of no scientific organization on the Rand have been more free from plagiarism and the other sin, commercial advertisement, than those of the S.A.A.E.

Blasting Gelatine.—The new form of blasting gelatine introduced some months ago by W.Cullen of the Modderfontein Explosives Works has not lived up to its early reputation. Certain unauthorized announcements gave one the impression that the underground workings were, by its use, being converted into a health resort for lung patients, but it must be acknowledged that Mr. Cullen's claims were guardedly expressed. The quantity of carbon monoxide produced is certainly less, but there is very little diminution in the nitric oxide given off, and practical experience has proved the modified explosive to be less efficient.

Technical Societies.—It is common talk that a well-directed and influential effort will be made to reconstruct some of the Transvaal technical societies. At present there is an undesirable overlapping, notably by the South African Association of Engineers and the Transvaal Institute of Mechanical Engineers. So far, the attempt to consolidate these bodies has been made in vain. The present project involves the re-casting of existing societies into three divisions dealing with (1) mechanical and electrical engineering, (2) mining, and (3) civil engineering. The popular Chemical Metallurgical and Mining Society would not be affected, though it would certainly lose the support of many mining men through the inception of a specializing body. In the meantime a new society has been formed, the South African Institute of Electrical Engineers, with an initial support of 71 members, 65 associate members, 14 associates, and 8 students. A few years ago a number of electrical papers were read before the South African Association of Engineers, but the rapid growth in the employment of electrical power and the promise of its far wider adoption have necessitated the creation of this independent organization.

TORONTO.

Statistics.—Returns made to the Ontario Bureau of Mines of the output of the metalliferous mines and works of the province for the nine months ending September 30, show a total value of $16,762,742 as compared with $12,185,511 for the corresponding period of 1908. The largest item is silver, which was produced to the amount of 18,751,549 oz., valued at $9,385,600, exceeding the output of the first nine months of 1908 by 6,170,039 oz. Iron ore was produced to the amount of 205,262 tons, an increase of 39,174 tons; and the output of pig iron was 294,698 tons, an increase of 105,411. The nickel production of 8912 tons, an increase of 1162 tons, was valued at $1,921,363, while copper showed a decrease of 309 tons, the output amounting to 5,583 tons.

Cobalt.—Ore shipments since September have been well maintained; those for November amounted to 2447 tons, the three leading mines being La Rose with 650 tons; Nipissing, 486 tons; and Drummond, 250 tons. The substantial advance made by the silver mining industry during the year is better indicated by the increased amount paid in dividends. The first dividends were paid in 1905 by the Kerr Lake and Temiskaming & Hudson Bay. The aggregate amount paid by 17 companies since the start, up to the end of the present year, will approximate $16,750,000, of which about $9,000,000 represents the 1909 payments. It is noteworthy that these conditions are not reflected in the stock market, which since the slump in La Rose has shown continued depression, especially as regards the cheaper non-dividend-paying issues. It is now abundantly evident that prices last year were inflated, and that the shrinkage indicates a disposition on the part of the public to regard actual values rather than speculative possibilities in making purchases. It looks as though the boom days of Cobalt were permanently over and operations in the future are likely to be conducted on a solid basis.

La Rose has been slowly recovering and the latest reports from the mine favour the opinion that the Lawson property may perhaps realize the high expectations founded on surface discoveries. It is showing up better at depth. Better ore has been encountered in driving at the 88 ft. level and a cross-cut to the west has tapped a vein of high-grade ore. In accordance with the promises of the new management vigorous development work is in progress on the University and Violet claims. The annual statement of the Nova Scotia showed $121,000 expended on development and over $50,000 on surface work. The engineers reported that there were over 1,600,000 oz. silver blocked out, assuring a net return for the first year of over $60,000. The company's indebtedness is stated at about $210,000. The shareholders have ratified a bye-law to increase the capital stock. A statement of the position of the Trethewey has been issued in connection with the sale to a syndicate of 54,550 shares of treasury stock at $1·50 per share. There are on the dump 45,000 tons of milling ore estimated to be worth $450,000. The ore reserves are estimated to contain from five to six million ounces of silver. The company has $200,325 cash in hand, while the value of ore in transit and at the smelters is $82,633. The annual statement of the Coniagas shows $128,477 in cash and $151,971 in ore under treatment; the dividend payable amounts to $120,000.

Oil.—Important evidence has been given before the Committee of the Canadian Senate by Alfred Von Hammerstein as to the great value of the oil-fields in Northern Alberta. Mr. Von Hammerstein has been engaged in exploring this region for the past eight years, and has spent $85,000 in the work, having drilled wells over an area of 60 miles in a locality 320 miles north of Edmonton. The wells, which vary in depth from 250 to 1200 ft., have revealed the presence of oil and gas in large quantities, and deeper drilling is expected to prove even more successful.

New finds.—At the Kerr Lake, a vein 3 in. wide running 4000 oz. per ton has been struck on the fourth level north of vein No. 3. At the O'Brien mine in the Gowganda district, known formerly as the Gates property, a 6 in. vein carrying high silver content has been found in the cross-cut at the 100 ft. level. Another strike of a 2 in. vein carrying ore of 6000 oz. per ton has also been made. Contracts have been let for the sinking of two 50 ft. shafts at the McKenzie mines, at Elk Lake, where assays have given encouraging results.

New goldfield.—Porcupine Lake is receiving an increased amount of attention and extensive purchases of claims are reported. The firm of McArthur & Co., of Glasgow, has acquired six locations at a high price. Despite the season the rush to the district continues and great preparations are being made for the forwarding of supplies and material during the winter. This camp will not labour under the disabilities that have handicapped

Kerr Lake and Crown Reserve mines, at Cobalt.

Drummond mine, Cobalt.

Gowganda and other extensions of the Cobalt district, as the Temiskaming & Northern Railway runs within a short distance, which is being covered by the construction of a road from Matheson, the nearest station. Rich samples from the surface are in evidence, but the value at depth is yet to be proved. Nevertheless, the formation of Porcupine Lake companies has begun and these flotations will no doubt be a conspicuous feature of the market during the coming spring.

Ore Stealing.—An extensive system of stealing high-grade ore from the Cobalt silver mines and disposing of it in Toronto for a fraction of its value has been discovered. Eleven men have been arrested, including Dr. John E. Wilkinson, president of the J. E. Wilkinson Co., Ltd., gold refiners of Toronto, with branches at Buffalo and New York. The others are miners, or men who have acted as go-betweens in buying ore and bringing it to Toronto. The detectives have been working on the case for some time, as the companies have been certain that they were being robbed on an extensive scale. Wilkinson's books show large receipts of ore, and a considerable quantity was found on his premises. The Wilkinson company does a large refining business and has hitherto borne a good reputation. Some estimates of the total losses of the companies by theft are as high as one million dollars per year.

Royalties.—The Provincial government has announced a reduction in the royalties to which some of the Cobalt mines are subject, from 25% on the gross value of the output to 25% on the net profits.

MEXICO.

The new mining law has passed through the Senate practically in the shape given to it by the Chamber of Deputies, and will become law in January. The most important change is that all litigation is removed from the influence of the local courts and will in the future be tried by Federal courts. The only feature that seems to have been entirely overlooked is the provision for the supply of reliable data by mine-owners to the Department of Mines, such as would form the basis for statistics to be published by that Department. At present it is difficult to find out if land is free or has already some old title attached to it. Compulsory registration, with a regular register published every six months and giving the names of mines, localities, and owners, number of claims, nature of mines, output, number of men, machinery, etc., with a list of mines whose titles have become invalidated would be a boon to mining men. This system of registration is published in Peru under the title of *El Empadrimiento de Minas*.

New railways.—Mexico is usually regarded as a silver-producing country, the amount of gold produced being insignificant in comparison. The principal gold-belts seem to be on the Pacific slope, especially in the little known and less developed State of Guerrero. There is a current rumour that the Dekay-Lipton interests will build a railroad from Cuernavaca to the Balsas river in Guerrero, and up the main valley. Credence is given to the rumour here, as survey parties have been at work. This line, while primarily planned for the cattle interests and for colonization schemes, would reach close to the gold-belt of Guerrero and would therefore assist in opening up a promising region. Another important railroad on which construction has already been started is the Acapulco-Zinhuatanejo line, which will run from the port of Acapulco on the Pacific up the coast to the little port of Zinhuatanejo. This is being built by Seattle-Vancouver capital and with a view to opening up lumber and banana lands, but it will greatly facilitate access to the mineral districts that lie between the valley of the Balsas and the coast, and if the Cuernavaca-Balsas line is also built the mineral range will have railroad communications on both sides. The building of the Guadalajara Chamela line by English capital is now stated to be a settled fact, and it therefore seems as if this whole section of Guerrero, Colima, and Jalisco will soon be opened up by cross lines of railway to the Pacific coast.

Native enterprise.—There is a steady increase in the amount of native capital being invested in mining and industrial enterprises on modern lines. The building of the large new cyanide plant at the Guadalupe mill, in Pachuca, by the Santa Gertrudis Co., is a notable example, and the generous treatment of the contractors White & Newcomb by the native mining company in the supply of labour, tools, and up-to-date appliances has created a precedent. This large and well equipped plant of 400-tons capacity was only started in the middle of September and at this date is practically completed, a remarkable performance for this *manana* country.

Electric Power.—The contract for the building of the Conchos dam in Chihuahua, and the great Nazas Federal irrigation project are both to be carried out by S. Pearson & Sons. In both of these projects, power and irrigation are allied ; power is to be transmitted electrically to the various agricultural and mining centres, and so indirectly the two industries help each other. The development of agriculture leads to the demand for the metals ; hence the mining community should assist the agriculturist, who is the final consumer of the produce of the miner.

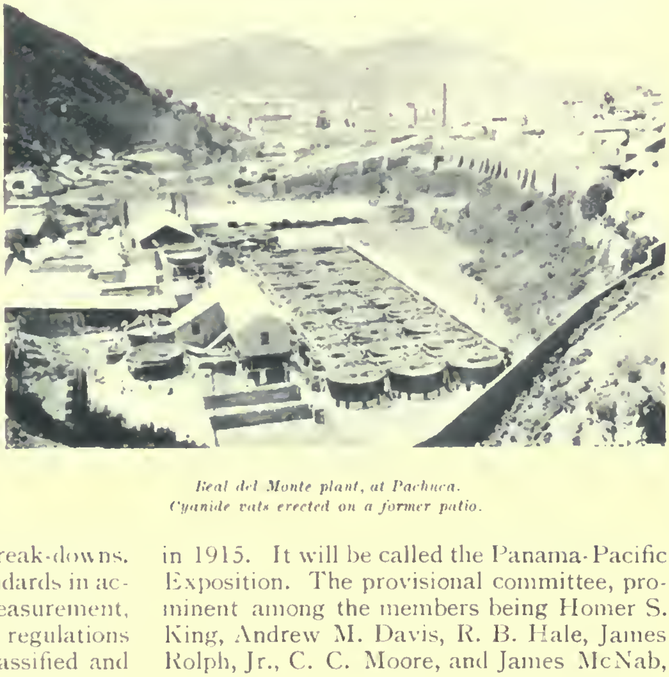
Mexico has land that could support many millions of well-to-do farmers, who would create a demand for a vast quantity of domestic silver, copper, iron, and zinc ; but before such a state of affairs can be brought about there must be a sweeping reform in Mexico's land laws and taxation in order that the huge *haciendas* may be sub-divided, and the landowners compelled to sell or lease the land on terms that will facilitate the development of a wealthy agricultural class able gradually to replace the present horde of half-starved *peones* who barely count as consumers. This is the only way in which Mexico can establish an assured market for her base metals, and stimulate an increase in the amount of silver required for coinage.

English trade.—It is hard to understand why the English trade with Mexico has fallen off, while both American and Canadian capital and goods are pouring into Mexico. As an example, the Great Conchos dam is being financed by Canadians and is to be built by English contractors but with American machinery. The English manufacturer is too conservative, he will not adapt the design of his goods to the requirements of the market. More money must be spent on the design and less on the manufacture, strength must be gained by scientific design not by brute weight of cast iron; it must be remembered that at some mining camps freight costs more than the original cost of the machinery and hence it behoves the designer to avoid every unnecessary ounce of weight. Roughness of appearance and lack of finish count for nothing as against facilities for freight, erection, and operation, and freedom from break-downs. It is also essential to build to standards in accord with the local system of measurement, and to study the customs laws and regulations so that shipments are properly classified and invoiced. I know of an instance where the erection of a plant was delayed for nearly two months, because the rivets for the cyanide vats were shipped separately after being classed as 'mining machinery,' with the result that a large part of the shipment was held up for re-classification.

Dividends.—Several Pachuca mines have declared dividends recently: the San Rafael y Anexas paid 86 pesos per share for the month, the Santa Gertrudis is paying 1 peso per share or 12% per annum, while meeting the cost of its new plant, the Maravillas has paid 4 pesos, the San Francisco hacienda 2 pesos, and the Guadalupe Fresnillo, 5 pesos per share. It is probable that extensions of these well established mines will be placed on the market, owing to the increase of interest in this district.

SAN FRANCISCO.

Another Exposition.—San Francisco recently celebrated its recovery from the devastation of the great fire of 1906 by a festival commemorative of the discovery of San Francisco Bay by Gaspar de Portolá. The event was brilliant and has whetted the appetite of the people for a more magnificent effort. A decision has been reached to signalize the completion of the Panama Canal by a world's fair



Real del Monte plant, at Pachuca.
Cyanide vats erected on a former patio.

in 1915. It will be called the Panama-Pacific Exposition. The provisional committee, prominent among the members being Homer S. King, Andrew M. Davis, R. B. Hale, James Rolph, Jr., C. C. Moore, and James McNab, has already notified the consular representatives of foreign countries resident in San Francisco. The engineers of the Panama Canal announce that the great inter-oceanic waterway will be completed beyond question by that date. This will be 400 years after the discovery of the Pacific by Vasco Nuñez de Balboa, who sighted the ocean from the summit of the range on the Isthmus of Panama on September 26, 1513. It is eminently appropriate that the cutting of the Isthmus should be celebrated by San Francisco. It will inaugurate a new era. The steamer route from Panama to the Orient, lying as nearly as possible along an arc of the great circle, constituting the shortest line between those points, would bring vessels within about 300 miles of San Francisco. Thus, with the opening of the Canal, this city will become necessarily a port of call, even for ships bound for China and Japan on voyages from the Atlantic coast of the United States and from Europe. The commercial advantages will also be such as to facilitate manufacturing and all industries in the Pacific States.

Litigation.—The times would appear to be particularly litigious, so far as the mining world is concerned. An outbreak of hostilities between W. A. Clark and the Amalgamated Copper company at Butte, Montana, is threatened. The difficulty has arisen over the Original and Stewart Mines, belonging to companies controlled by Mr. Clark. The limits within which mining could be done on these claims were restricted, and it is affirmed that much ore has been extracted from adjacent ground pertaining to the Amalgamated. On the other hand, there must be points involved that complicate the situation, for if the Amalgamated had a perfectly clear case it would display no disposition to compromise, and it is well known that the Amalgamated in the past has offered to buy these claims from Mr. Clark. It is now said that filing of suit is delayed pending negotiations from the great copper merger.

Ore-Stealing.—At Goldfield action has been taken by the leading gold-producers to balk the 'high-graders' by rendering it more difficult to dispose of their booty. An injunction has been obtained on the application of the Consolidated, Florence, and Combination Fraction companies against several assayers restraining them from buying ore, concentrate, precipitate, and bullion, without first notifying the plaintiffs, and permitting an inspection to be made. It is claimed that out of small shipments made from Goldfield by the Wells, Fargo & Co.'s express between June 1 and October 1, amounting to $31,000, no less than $26,000 represented gold stolen from these companies. The appointment of J. R. Finlay to the managership of the Goldfield Consolidated is viewed with great interest. He will succeed J. H. Mackenzie on January 1, the latter retiring in order to attend to his numerous other interests but retaining the position of consulting engineer. Mr. Finlay has had a wide and honourable experience in the mines of the West. He is forceful and resourceful as a man, quite apart from his known technical ability, and is recognized as one of the best informed engineers in America. In every way he is a worthy successor to Mr. Mackenzie, who has rendered such great service to this remarkable mine. The Goldfield Consolidated has produced considerably more than $5,000,000 during the current year, which gives it the largest output of any gold mine in the world.

Copper.—Matters in the copper world have not been so much in evidence of late, except as regards negotiations for the merger. The price of the metal has materially improved, due in no small degree to heavy orders from England. The production, however, is sure to increase if the price mounts. The independent producers are too many to be controlled by one organization. The United States Steel Corporation could not control the iron output, and copper is more difficult because of the smaller capital on which a mine and smelter may start. Control of selling agencies, after the manner of the Standard Oil, is conceivable. It is reported that the Cole-Ryan people, who have become the most important influence in copper production in the West, will supplant the General Development Co. in the control of the Miami mine at Globe, Arizona. The amalgamation of the Cumberland-Ely with the Nevada Consolidated at Ely, Nevada, was followed by the closure of the Veteran mine. It is improbable that it will be re-opened. The cost of mining was not brought down by the top-slicing caving method to a figure that admitted of winning a profit on the low-grade ore produced. The Greene-Cananea in Sonora, Mexico, shipped 3,424,000 lb. of copper during November. It is said that the ore developed, and the present equipment on this property, would permit of an annual production of 75,000,000 lb. The railroad that this company so bravely started out to build across the Sierra Madre as an outlet to the East, has been abandoned, the difficulties between the Cole-Ryan interests and the Southern Pacific railroad having been adjusted.

CAMBORNE.

Dolcoath.—This is the oldest tin mine in Cornwall, its birth dating from 1737. It is the deepest mine in this classic county of mining, and is also the oldest and deepest tin mine in the world. But it is only a baby compared with some of the Continental copper, silver, and lead mines which are still large producers of minerals. Dr. Borlase in writing of Dolcoath said it was a very considerable mine in 1746. In 1787 the mine was 132 fathoms deep and had produced copper ore to the amount of £1,250,000. Rev. Edward Warner of Bath wrote in 1808 that " Dolcoath had torn out the very bowels of the district." From a rich copper mine Dolcoath developed into a rich tin mine, after passing through the usual 'barren zone,' and has paid dividends with the regularity of clockwork. In fact, the shares were regarded as safe as Consols, and at one time were all locally held. During the last half-year, from July to December inclusive, nearly 1000 tons of black tin and slime tin were sold at the average price of nearly £80 a ton, an increase over the price realized for the corresponding period of 1908. The average for the last sale, on December 28, was £93 exclusive of slime tin. A good profit will be shown for 1909, but only a small dividend is to be expected, as some funds will be devoted to the equipment of the new shaft. From August 1865 to December 1889 this mine paid a total of £648,000 as dividends and sold over 43,000 tons of black tin, which realized nearly £2,500,000. The dues paid to the landowner amounted to £157,191. From July 1, 1895 to June 30, 1909 the shareholders have received £453,396 and the landowner £100,255, and the amount expended in sinking Williams shaft, erecting buildings, cottages, new machinery, plant, etc., was about £94,000. The total amount of ore crushed every year is now nearly 100,000 tons.

South Crofty. During 1909 this mine made a remarkable increase in production of tin, wolfram, and arsenic, the latter of which is now sold as refined arsenic. The increase in the number of tons of black tin was 249 tons over 1908, being 681 tons as against 432 tons, and the increase in value was nearly £19,000. The production of arsenic has increased not only in tonnage but in the price obtained. It is pleasant to be able to record that the company is now on the dividend-paying list, 3s. per share having just been declared for 1909. Palmer's engine on the eastern portion of the mine has ceased working, and Robinson's engine easily handles the water from the 225 fathoms level. It may be mentioned that tin streamers on the Red River do not like the South Crofty treating its complex ores left in the upper levels by the old owners. Slime from these ores contains too much arsenic, chalcopyrite, pyrite, and wolfram to suit their purpose. It means less tin caught and more expense in dressing and roasting.

Grenville Mines.—These mines show some improvement during the past year. The output was nine tons greater than in 1908, and the revenue increased from £49,457 to £50,274. The loss during 1908 was over £500 per month and no dues were paid, this being a mine which pays royalties on profits. During the first six months of 1909 the losses were only £300 per month, and during the last half-year the loss has been further decreased. With a new shaft well equipped, south of the present workings, these mines would soon re-enter the dividend list, as the prospects are decidedly encouraging. The coal bills are a very heavy item, as in addition to there being an extensive area to drain, there is the cost of haulage, as the mine is not on the line of railway.

Basset Mines.—During 1908 these mines made a loss of over £360 a month, but in 1909, in spite of troubles with machinery, the mine will show a better statement, as the sales have increased in value by nearly £8000 over 1908, reaching a total of £53,730. Development is kept well ahead, and all that is wanted is some richer ore. The output would be greatly increased if tributors were encouraged to find the ore as well as to mine it.

West Kitty.—This mine has had a series of misfortunes during the past three years. Early in 1909 the London directors were asked to give place to local directors and the head office was removed to the mine. Reynolds' and Thomas' sections were stopped, in spite of the fact that they supplied two-thirds of the production and profits over a series of years, and work was concentrated at Wheal Friendly, both underground and at surface. Two of Holman's air-cushion stamps were erected, and also Wilfleys, Frue vanners, frames, etc., at a cost of several thousand pounds, but these are now idle on account of a treacherous foundation. In October a new manager and a new engineer were appointed, and it was thought that the mine had again started on a prosperous career, but unfortunately not so, as the sales have decreased from 20 to 15 tons a month; in fact the decrease during the year has been 100 tons. Wheal Friendly lodes carry tin throughout, but not enough under present conditions to pay; on ore carrying 25 lb. of black tin to the ton there has been a loss of 4s. per ton. The mine is now being handed over to the St. Agnes Consolidated Mines Ltd., a new company formed by the National Minerals Corporation for the purpose of acquiring a number of setts in the district. But judging by the record of this group of financiers, at Clitters, Wheal Jane, and St. Ives, the new arrangement at West Kitty is a decidedly doubtful blessing.

China Clay. The dispute between the Great Western Railway and the Carpalla China Clay Co. as to whether china clay is to be reckoned a mineral has been finally settled by the judgment of the House of Lords. Their lordships agreed with the opinion of the lower courts that china clay was undoubtedly intended to be classed as a mineral under the Railway Act of 1845.

METAL MARKETS

COPPER.

The violent fluctuations in prices that had characterized the previous month gave place in December to a steady improvement in values, and to a settled and increasing demand from the trade. The calmer condition of the money markets contributed in no small measure to this desirable condition of affairs, due mainly to the continued increase of consumption and the agreement among the leading American producers to restrict their output to the extent of 10%. The much discussed merger, it is true, has apparently been postponed, but the way is being paved for the greater measure by a consolidation of the Utah, the Nevada Consolidated, and the Boston Consolidated interests, while similar combinations in other directions are reported to be pending. The Butte mines are reported as closed down in connection with the railroad strike.

Three months standard copper stood at £59. 5s. when the month opened, and gradually rose to £63 at the close, with occasional profit-taking relapses; at no time, however, during the month was the market under the influence of more than a temporary reaction, and the volume of trading was large and the sentiment optimistic. American selling agencies have now withdrawn from the market altogether, and the American price has been raised to 14 cents.

The American Producers' figures for November appear to show that the high-water mark in production there has been reached for some time to come, while American consumption is increasing at a wholly satisfactory rate.

The December figures show stocks, on January 1, of 141,766,111 lb., against 153,003,527 lb. on December 1. Production for December was 117,828,655lb., against 121,618,369lb. in November. Exports were 60,000,000 pounds. In Europe stocks are still accumulating, but less rapidly than they were, and improving business is reported in all trades. In America the improvement is especially noteworthy. The German electrical industry is buying as largely as at the best of times. Increasing business is reported for India. Our own brass trade is doing well, and a better demand is experienced from other European countries. Altogether the prospects of the industry are decidedly promising, with an expanding consumption and a prospective steadiness of output.

Average prices of cash copper:

December 1909.	November 1909.	December 1908.
£60. 1s. 0d.	£58. 19s. 4d.	£63. 1s. 5d.

TIN.

The market has again witnessed one of those spectacular variations in prices not infrequent in this commodity. The bull party has been exceedingly active and assisted by the urgent demand from consumers, especially in the United States, has pushed up prices from £145 early in December to £155. 15s., the highest price for the year for three months' delivery. The bears have not been aggressive; every relapse has induced them to cover, and helped the upward trend. After the Christmas holidays fresh large orders from consumers came to hand and good business was done both with the East and the Metal Exchange, but the prospects of heavy shipments—estimated at £5900—caused a decline from the highest, so that the month closes at £154. 10s.

Average prices of cash tin:

December 1909.	November 1909.	December 1908.
£149. 2s. 3d.	£140. 0s. 3d.	£132. 4s. 7d.

LEAD.

The loss of Australian supplies through the coal strike left the market dependent on Spanish and American lead. The American demand, however, is exceedingly good and stocks have become depleted. Dulness produced by the abstention of buyers has given place to an active demand from rollers, cable-makers, and others. A fresh speculative interest has developed on the part of dealers for forward metal; values have consequently improved about 20s. per ton, with prospects of a further improvement. The continental demand has not developed yet.

Average price of soft foreign lead:

December 1909.	November 1909.	December 1908.
£13. 2s. 10·43d.	£13. 1s. 4·70d.	£13. 3s. 5·93d.

SPELTER.

The galvanizing trade is brisk and sheet-makers in some instances are sold out for some time ahead. The exports for 1909 are likely to constitute a fresh record. The brass trade has likewise taken good orders; in consequence, consumption of spelter is heavy and producers' stocks are reduced. A continuance of the demand is likely after the turn of the year as consumers have not covered all their requirements.

Average prices of good ordinary spelter:

December 1909.	November 1909.	December 1908.
£23. 1s. 3d.	£23. 3s. 4d.	£20. 19s. 1·77d.

PERSONAL

G. PERCY ASHMORE has returned from German Southwest Africa.

W. J. BARNETT is on his way to Chile and Argentina.

A. C. BEATTY is expected in London.

GEORGE BLAKE-WALKER has returned from Edmonton, Canada.

C. A. BOHN, lately in Mexico, has been promoted to the New York office of the American Smelting Company.

R. GILMAN BROWN, on his return from Siberia, has gone to Tunis.

CHARLES BUTTERS is expected at San Francisco from Salvador.

W. A. CARLYLE was in Norway during the holidays.

GEORGE CHALMERS received suitable testimonials on completing 25 years of service as superintendent of the St. John Del Rey mine, in Brazil.

J. H. CURLE is on his way to the Rand.

THEODORE DWIGHT was at Guanajuato, Mexico, in December.

W. R. FELDTMANN has returned from the Gold Coast.

J. R. FINLAY is now general manager of the Goldfield Consolidated mines at Goldfield, Nevada.

WILLIAM FRECHEVILLE is on his way to Pahang, in the Malay States.

R. J. FRECHEVILLE has transferred his office to Salisbury House.

D. GILL-JENKINS is superintendent for the Sudan Goldfield Co., in Egypt.

SELWYN GOLDSTEIN, formerly metallurgist to the Great Boulder Proprietary, has been appointed manager of the Tominil mine, in Mexico.

C. HANCKEL is at Broken Hill.

F. O. HARVEY was recently in Spain.

C. S. HERZIG is at New York.

W. A. HEYWOOD is in the Caucasus.

ALEXANDER HILL is recovering from a serious illness.

HOOPER, SPEAK, & FEILDING have taken offices at No. 3, London Wall Buildings.

L. H. L. HUDDART is now Director of Mining in Northern Nigeria.

H. F. JULIAN has returned from New York.

C. B. KINGSTON has returned to Johannesburg.

CHARLES KIRCHHOFF has voluntarily ceased to be editor of *The Iron Age*, New York.

R. B. LAMB has returned to New York from Parral, Mexico.

CARLOS W. VAN LAW is manager for the Real del Monte mines, at Pachuca.

W. J. LORING was in New York during December, and is now at Toronto.

J. T. MARRINER has left the Straits Settlements and is now in Western Australia.

H. F. MARRIOTT sailed for South Africa on January 8.

T. D. MERTON is on his way to Australia.

ARTHUR L. PEARSE has returned from Alaska.

WALTER G. PERKINS intends to remain and open an office in London.

C. W. PURINGTON has returned from a short visit to St. Petersburg.

FORBES RICKARD was recently in Durango, Mexico.

N. SAMWELL passed through London, on his return to Burma, after a visit to the gold-dredging region in California.

F. F. SHARPLESS is here, on his way to West Africa.

S. J. SPEAK is in Argentina.

R. DE H. ST. STEPHEN has been examining copper mines in Jamaica.

G. A. STOCKFELD, manager of the Abosso mine, has returned from West Africa.

LESTER W. STRAUSS is examining copper mines at Tocopilla, in Chile.

LEONARD C. STUCKEY has been appointed manager for the Copiapo Mining Co., in Chile.

W. F. A. THOMAE is in the Orient.

GEORGE E. TILLY has returned to Barranquilla, in Colombia.

TUDOR G. TREVOR is Inspector of Mines in the Barberton district of the Transvaal.

WALTER S. WHITWORTH is manager of the Koffyfontein mine, in the Transvaal.

A. G. B. WILBRAHAM has returned from Rhodesia.

R. A. VARDEN will be in Brazil for several months.

A. STANLEY WILLIAMS is in France.

LEWIS T. WRIGHT is expected in London from San Francisco.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Copper Smelting.

The Editor:

Sir—Referring to Mr. C. H. Jones' article 'Copper Smelting in the Argentine,' it seems to me, as far as the ore was concerned, that conditions were favourable for pyritic smelting, using a small percentage of fuel (2 to 6) to ensure the proper working of the furnace. I understand that the undertaking was finally abandoned because of the lack of ore. I cannot see why, with a properly prepared and suitably computed charge there should have been so much over-fire as mentioned by him. This would indicate that the fuel was used in large excess. The slight warming of the blast from the hot down-take must have been trifling and cannot seriously have affected the operation of the furnace. For a furnace of the size used a closed tap-hole opened periodically would have served; there would have been no question of carrying all the blast-pressure needed. When blowing-in, so much fuel seems excessive. With an ignited bed of fuel to just above the tuyeres it should be possible to operate the furnace by then proceeding immediately to the addition of slag-charges, carrying not more than 15 to 20% fuel. When the feeding of regular charge began, the fuel could be cut to the proper ratio.

L. S. AUSTIN.

Salt Lake City, November 26, 1909.

Transport in Argentina.

Reverberatory furnace at Pilciao.

The Editor:

Sir—I have read Professor Austin's criticism with keen interest; but his statements do not convince me that results would have been materially modified by adopting the suggestions he now offers. His view that the ores mentioned can be smelted pyritically was my own before attempting to do so. The pyritic ore with quartz undoubtedly would, and did, smelt pyritically; but after many trials, I was quite satisfied that the 'silicious' ore and pyrite would not; its free quartz was in grains too fine and too much of the 'insoluble' existed as combined silicates. The over-fire produced with these silicious ores, I hardly think was due to excessive fuel, as less than 5% of charcoal was generally used, but rather to want of sufficient chemical heat at the zone of fusion. Intermittent tapping of the furnace would scarcely have been possible with the labour available. The ton of charcoal for blowing-in was the amount debited against the furnace; frequently less was used, depending on the quality, as much of it had been made in heaps and contained 'smalls,' sand, and half-burned wood. It stood about two feet above the tuyeres when the first slag-charge was added.

CHARLES H. JONES.

London, December 14, 1909.

Royal School of Mines.

The Editor:

Sir—Occasionally there still appear, in after-dinner speeches and in print, very distinct echoes of the thunders of denunciation of the Imperial College of Science and Technology, such as arose when the incorporation was first proposed. As a continuance of useless grumbling is decidedly mischievous in delaying the necessary harmonious working of all portions of the Imperial College, and as it nearly all arises from ignorance of some important facts, a few words may be useful.

At the time when the Council of the Institution of Mining and Metallurgy took up the question of the condition and future of the

Royal School of Mines, no organized body of old students existed which showed any signs of doing anything, except dine together once a year and talk of the glories of the past. The then students and the old students were quite happy to be represented by the Council of the Institution to which so many belonged, and which was ready to spend money and labour in saving the school and improving it. The only official organ of the old students—their digestive organ—the annual dinner, blessed the efforts of the Council of the Institution; and on one special occasion a programme was marked out and unanimously adopted for the ultimate guidance of the Council. That programme was secured by the Royal Charter incorporating the Imperial College of Science and Technology, which preserves the identity, the name, and the diploma of the Royal School of Mines. But because the charter also preserves the identity of the Royal College of Science and the City and Guilds College, whose students are just as loyal to their colleges as are those of the Royal School of Mines, there are still grumbles abroad without respect for the will of the great majority, and oblivious of their own impotence in the past to stem the movement of time. What were the conditions of the past?

The Government had made for some years an annual grant to "Royal College of Science, with which is incorporated the Royal School of Mines." This very title would indicate that the irreconcilables of incorporation of any kind ought to have got a little used to the irremediable. The grant was enough to support the existence of the School of Mines, but not to allow any growth. The heads of mining and metallurgy looked to a living outside the school and could not give their whole time to it. There was no money for equipment, and no chance of any new buildings. Other schools of mines had grown up in the country, were supported locally, and the Government could not be expected to make any extravagantly endowed pet out of the London school. There was no sign of a big subscription among the old students of the Royal School of Mines to properly endow it; although the annual dinners showed in other directions an unbounded enthusiasm.

At present the Imperial College is going to spend over £100,000 on a new building for the Royal School of Mines and for the Department of Geology. A large sum has been provided for a special equipment such as other schools of mines have had, but the London school has never possessed. In addition to this provision of adequate quarters, the heads of mining and metallurgy are receiving a proper remuneration for services, which they did not in the past. The governors of the Imperial College are also bearing in mind the comfort of students and the cultivation of a proper *esprit de corps* for the College as a whole, by providing money for the erection of a large building for a students Union, in which proper facilities for lunching (not now available at South Kensington) will be combined with meeting-rooms, gymnasium, and facilities for social functions of all kinds. Such a Union is most desirable, and need not destroy any existing clubs or unions of a more limited character.

In face of these facts there is no use for a small minority whining about the past; it is stupid; it is unsportsmanlike; and it is opposed to the true future interests of the Royal School of Mines.

H. M. S.

London, December 15, 1909.

[We are glad to publish this outspoken letter from one so well informed. The argument as to recognizing the logic of events is in accord with our own expression of opinion as published on page 258 of the December issue of this Magazine.—EDITOR.]

Speculations and Investments.

The Editor:

Sir—Prof. Moriarty seems to have overreached himself and Mr. Sherlock Holmes is still triumphant. The Professor suggests that Utah Copper and Nevada Consolidated should not be moved into the first column, because the one is producing only 24 lbs. of copper instead of 28 lb., and the other has been 'flimflammed' not only out of its ownership in the railway, but more recently has taken over Cumberland-Ely by the issuing of 400,000 new shares, on a basis of 3¼ to 1, against an intrinsic value of about 8 to 1, and thereby putting Nevada Consolidated on a 5% basis with money back, and copper at 12½ cents.

The Professor is wise in his deductions as far as he goes, but he does not go far enough. We are now in the throes of a copper combine that it is proposed will consolidate most of the 'tripe' with a sufficient leaven of additional tonnage to stave off the day of reckoning, which, like Banquo's ghost, will not down, and can only be temporarily placated by share-juggling and tips, with a sufficient modicum of additional tonnage to fool the public. We are informed most solemnly that this new combine will reduce the cost of producing copper by approximately 3 cents per pound. If true, this is a sad commentary upon the ability of the present managers of Amalgamated, Anaconda, Utah Consolidated, Utah Copper, Nevada Consolidated, Butte Coalition, Calumet & Arizona, Greene-Cananea, and North Butte. If the maximum cost now is 12c. and the minimum cost is 7c., under the new billion-dollar merger, financed it is said by J. P. Morgan, we shall see maximum costs of only 9c. and minimum costs of only 4c. per pound. This reduction, of course, must be brought about by the sagacious management of J. P. Morgan, and by that alone, because no engineer or official now connected with any of the copper companies has such transcendent ability. Great indeed must be the House of Morgan to work such economies in copper production ; but will it ? We are given tips that it will. If so, with Utah at 5c. and Nevada at 4c. per pound, they certainly deserve rank in the first column. Probably Mr. Sherlock Holmes or Prof. Moriarty may be able to deduce the correct answer to the problem, and relieve the anxiety of a long suffering public.

OLD SLEUTH.

Boston, December 12, 1909.

The Labour Problem.

The Editor :

Sir—I have been much interested in Mr. Shockley's review of H. C. Hoover's 'Principles of Mining' appearing in the September issue of your Magazine. My experience with cheap labour in Mexico is in accord with Mr. Shockley's contention that there is such a thing as cheap labour. The following comparison between work done here and in countries where cheap labour does not exist may be of interest.

In the Zacatecas mines, as is the case in many other Mexican districts, drilling is quite generally paid by the metre. The system takes two forms : first, payment by the day, with a minimum of so many metres of drilling ; and second, payment by the metre, permitting the men to drill as much as they can. The latter is employed at the San Roberto mine, where the price paid is 40 cents (U.S. currency) per metre, with a bonus of 4 cents for every drill-hole measuring 90 centimetres or more. A hole less than 50 cm. deep is not received unless previously required by the shift-boss, who points all holes, names the depths to which they are to be driven, and notes all 'friends' remaining from the previous round. The price is uniform, though the rock varies in hardness ; the drillers are given equal opportunity by a system of rotation from place to place.

To the low wages of Mexican labour must be added the cost of supervision. If a Mexican shift-boss is employed the supervision item will apparently be small, for he can be had for $1·25 per day as against the white shift-boss's salary of $7·00. But the native boss, though perhaps industrious and an excellent finder and follower of ore, is often dishonest in recording drillings ; he may exhibit judgment in pointing and loading a round, but is also almost always addicted to drink ; hence he is more unreliable. I think that when the working force reaches 15 sets of drillers with its complement of timbermen, shovellers, and trammers, the leakage due to Mexican bossing may be greater than extra wages paid to a reliable white shift-boss. Such a man can handle 30 sets, or more, since the shovellers' and trammers' work can be advantageously put on contract. From the written daily reports collected during more than a year's work I find that the average drilling accomplished by native hammer-men, in moderately hard rock, working double-hand, is better than three

TABLE OF COMPARISON.

	Zacatecas Labour	White Labour
Sets, or pairs, of drillers per shift	30	30
Metres drilled by each set, per shift	3	5
Proportion of shift-boss's time chargeable to drillers	$5·00	$5·00
Cost of supervision per metre $\$5 \div (30 \times 3)$	0·056	
and $\$5 \div (30 \times 5)$		0·03
Cost of labour per metre (white wages taken at $3 50)	0·40	1·40
Total cost per metre	0·46	1·43

metres per set per shift. In the table I allow five metres (16·5 ft.) for a white pair, which in this rock would be excellent work. This is more than 3 to 1 in favour of cheap labour.

HUGH R. VAN WAGENEN.

Zacatecas, December 1, 1909.

Rand Metallurgy.

The Editor:

Sir—In your comment on my paper, 'Metallurgy on the Rand,' which appeared in the September issue of your magazine, you rightly call attention to the fact that G. A. Denny tried the Dehne filters in the treatment of slime, several years ago. As you say, the expense was prohibitive. Why? There are several reasons, one of the chief being the method of discharging the residue, when using the Dehne filter. This doomed the press as far as the Rand is concerned.

When I mentioned the use of filter-presses for the Rand, I had in view solely the Merrill press. I should like to see this machine given an impartial and extended trial on the Rand, on a working scale. It is my opinion that it would prove the best method in the long run for the treatment of Rand slime.

People do not sufficiently realize the excellent work the Merrill press is doing at the Homestake. Suppose that at Johannesburg the original value of the slime treated by decantation were to contain only 80 cents per ton, which is the value of the material treated successfully by the Merrill presses in South Dakota, what would be the result? A poor actual extraction, I think. On the better grade mines on the Rand, the slime thrown away (at least, until quite recently) assayed more than 80 cents per ton. In other words, in the South Dakota gold mine, they start where many of the Rand mines leave off.

If filter-presses are to be used on the Rand, I am of opinion that the Merrill will prove the most satisfactory. With plants already in operation, it is questionable whether these innovations would be justifiable. My advice relates to new plants.

T. LANE CARTER.

Tunky, Nicaragua,
November 1, 1909.

[This suggestion is likely to receive consideration for several reasons, among others because Mr. F. L. Bosqui is now on the Rand, at the instance of Wernher, Beit & Co., in order to ascertain whether filter-presses should be introduced in local practice.—EDITOR.]

West Africa and the Klondike.

The Editor:

Sir—In the first issue of your Magazine you say: "This Magazine is controlled by the Editor: it is therefore free to pass fair criticism, just condemnation or sincere praise upon any action or event affecting the integrity of the mining profession or the development of the mining industry." On the same page you say: "Among the contributors to this issue is Mr. J. H. Curle, the author of 'The Gold Mines of the World,' a traveller, mining engineer, and writer whose outspoken utterances have impressed the Public and the Market more than once."

In the first sentence quoted there is an invitation that I feel bound to accept. Mr. Curle, being a man of outspoken utterance, will not object to fair criticism. If his utterances impress the Public and the Market, criticism of them becomes a public duty. I am sure therefore that you will give this criticism the same publicity that you give to his utterances. To impress the Public and the Market for or against any legitimate mining enterprise means the assumption of serious responsibility. In his haste to travel, to write, and to impress, Mr. Curle entirely overlooks this most serious aspect of his endeavours. In his review of West African mines in your Magazine, Mr. Curle colours the whole of this goldfield in a rosier hue than any mining region that he has ever visited.

Transportation he pronounces good. The native, he says, is clever, and can be transformed by Sunday clothes and phonographs into a better and more intelligent workman than any of the species *Homo* with a skin any shade beyond white, better even than a Chinaman. The only obstacle is the mosquito, the bearer of malaria; and he shows how that can be readily overcome.

Recall now what he says of the orebodies. "The richer zones (speaking of the West African banket) appear more clearly defined than on the Rand, and evidence is favourable to their persistence in depth. These richer zones have been found so far in Taquah, Abosso, Cinnamon Bippo, Abbontiakoon, and Wassau. . . . . The average value to be recovered from this ore (about 48 in. wide) for the first 800 ft. of depth I shall figure at 30 shillings per ton. This is better than the Rand. . . . . As regards working cost, the Taquah field is the better favoured of the two." In other words the West African field has richer ore, and can be worked more economically than the Rand. Impressed by Mr. Curle's utterances, the public are no doubt investing their money in West Africans.

Again he says: "As it stands today, Prestea Block A is one of the finest quartz mines in the world. If there exists that relation between the length and depth in an ore-shoot that some of us hope, before we die, to reduce to a formula, then the history of this mine should be a striking one for a number of years to come." Speaking of Justice's Find he says: This is the ugliest orebody I ever saw —a mere impregnation—but it is 80 ft. wide, worth over 40 shillings per ton, and is already proved to a third level. After this the Ashanti Company is capable of anything. . . . From Ashanti to Prestea, a distance of 70 to 80 miles, there is a gold belt as yet unprospected. . . . . A gold belt lying between two such mines as Prestea Block A and Justice's Find should be prospected to the tune of a million pounds."

Now let us turn to 'The Gold Mines of the World,' 5th edition, 1905, and see what Mr. Curle had to say regarding these same properties only four short years ago. Here is what he says: "Whereas the Rand beds carry their width and their values over great areas both in length and depth, it is doubted whether at Wassau the length of payable ore extends at the surface through more than two or three mines, while in depth, even moderate depth, it is feared that it goes badly wrong. The best shoot of ore seems to be that in the Wassau mine, but it is a small reef, and working costs are high. The good ore too seems to be plainly limited to one section of the mine, and the ore reserves are out of all proportion to the capital of the concern." This is very indefinite writing for a man who is so punctilious in his demands upon other people in regard to thoroughness, honesty, and capability. Continuing he says: "The West African quartz mines, so far as can now be seen, look to be only lenses of ore. . . . So far the prevailing characteristic has been a rich outcrop, a hopeful outlook for perhaps a couple of hundred feet, and then a steady diminution of gold contents. . . . Two years hence this list will be longer." This is very discouraging. Such raven-winged prophetic utterances suspended over our heads would certainly impress the Public and the Market, and would thereby put another obstacle in the path of the dauntless pioneer, at whose end of the table Mr. Curle is evidently not in attendance.

In his recent review, Mr. Curle does not say how deep is this third level in Justice's Find. I assume about 200 ft. Why does he now take such a hopeful view of any orebody proved for "perhaps a couple of hundred feet," particularly in the case of such an "ugly" orebody in this West African goldfield, where only four years ago there were no mines, the best appearing of them being characterized by him as a 'concern,' and the orebodies mere 'lenses' of ore?

Not knowing Mr. Curle personally, I do not know which of two possible constructions to put on his changed front with respect to West Africa. It would seem that he has been useful to Wernher, Beit & Co. Can it be said that he has exerted a beneficial influence on the development of these 'lenses' and 'concerns,' or that he has been as useful to their former owners as to Wernher, Beit & Co.? Both in 1905 and 1909 his utterances were outspoken. On both occasions it is possible that they impressed the Public and the Market.

Mr. Curle must have erred unwittingly. But the public cannot on that account overlook so grave an error in a book of such pretensions as 'The Gold Mines of the World,' which goes through three editions.

Mr. Curle visited the Klondike in the early days of the camp. With reference to quartz mining in this country he says: "There are no quartz mines in the Klondike, nor in my opinion, although valueless quartz stringers are frequently visible, will there ever be. People talk of a 'Mother Lode' from which all the gold in the gravels has sprung; but there is no reason to believe in the existence of such a phenomenon. On the contrary there is every reason to believe that the gold existed in a great volume of low-grade quartz, and that it is to the subsequent erosion of this quartz and the concentration of its metal contents that the wealth of the Klondike is due."

I venture to say that Mr. Curle knows no more about the gold distribution of the Klondike than Harry De Windt, and a great deal less than our old friend Jack London. Take for example Bonanza and Eldorado creeks. By all men void of prejudice these two creeks are admitted to have been the richest that history records. There may have been small areas of auriferous gravel richer than any in the Klondike, though it is doubtful. But Bonanza from Victoria gulch, above which it is barren, and Eldorado from Gay gulch to its junction with Bonanza, were undoubtedly the richest that the world has known. These two creeks take their gold sources on opposite sides of the same hill, Bonanza on the right, and Eldorado on the left side of it, looking down stream.

The gold of Eldorado has been followed up Gay gulch and Oro Grande to this hill. The gold of Bonanza has been traced up Victoria gulch to the opposite side of the same hill, where even on the steep hillside, where there is no gravel, several miners find it rich enough to wait for a shower of rain to assist them in their work. This hill is known as the Lone Star hill, and quartz veins have been found in it richer than Mr. Curle records in his latest utterances on West Africa. And let me inform Mr. Curle that they are not mere 'lenses' of ore, and that evidence is favourable to their persistence in depth.

It is not assumed that Bonanza and Eldorado have been fed from the top of the hill, as if gold were in the habit of running down like water. The top of the hill is 1700 ft. above the creeks. The lodes lie in a fissured belt that extends across the heads of Victoria gulch, Gay gulch and Oro Grande, and across Eldorado itself, Eldorado being the only creek in the country that cuts right through it. The auriferous lodes lie in the part of this belt that has not been eroded.

Let me quote, from the Blue Book issued by the Dominion Government, the report of Mr. McConnell, who has made a more minute examination of the country than any other geologist. "The richest quartz so far discovered occurs near the head of Victoria gulch, a tributary of Bonanza creek. The partly decomposed slide-rock covering the surface of the hill below the quartz outcroppings, contains colours of gold and it is significant that Bonanza creek is rich below the mouth of Victoria gulch and practically barren above. Victoria gulch is itself gold-bearing, and the gold obtained from near its head is sharply angular. It is not inferred from this that all the gold in Bonanza creek came from Victoria gulch, as none of the heavy gold has travelled far, and the valley was probably repeatedly enriched from veins along its course, and from the older gravels, but that some of it was so derived seems certain. This is somewhat different from what Mr. Curle says.

On page 64 of his report Mr. McConnell says: "The most interesting group of quartz veins in the district is that referred to before as occurring near the head of Victoria gulch. The development work done on these consists of a few shallow shafts or pits, none of which reach any considerable depth, and a short tunnel. At one of the openings on the new Bonanza claim a short rich kidney of quartz, nearly six feet in width, was uncovered. A second opening, 200 ft. to the south-east, has been sunk, following a smaller quartz vein in which no free gold could be detected with the naked eye, or an ordinary magnifying glass. A sample was assayed in the laboratory of the Survey and gave 2·625 ounces of gold and 3·267 ounces of silver to the ton. . . . . The coarse angular gold in Victoria gulch and No. 7 Pup must have been obtained from these veins or from neighbouring ones concealed beneath the surface covering or wholly destroyed by erosion. Work on them is now temporarily stopped, but the prospects are certainly encouraging and warrant further investigation." This is not so discouraging as Mr. Curle. The property in which these veins occur was involved in a series of lawsuits and disputes. These have all been settled and the titles perfected; and the development work is now going ahead on them.

In favour of this fissured belt crossing the heads of the creeks and gulches constituting what may be called a Mother Lode to Bonanza and Eldorado, the evidence cited by McConnell is stronger than McConnell's construction of it allows. As to how far and by what agencies the creek-gold has been carried is a question by no means easy to settle, but it has certainly been subjected to considerable attrition, compared with the gold of Gay gulch, Victoria gulch and Oro Grande. Along these gulches, particularly at their upper ends, the gold is rough, sharp, and angular, often exhibiting unworn crystals of gold that are indistinguishable from the crystals of gold that are found in the quartz veins in situ near the summit of the ridge between Bonanza and Eldorado creeks, at the head of Victoria gulch. Down the courses of the creeks there is no such evidence of gold having dropped out of its quartz matrix in its immediate vicinity.

Furthermore, if the creeks received their gold from the erosion of a general distribution of even low-grade quartz in the schist they would be poor at the upper ends and gradually get richer down their courses. But the exact opposite of this is the case. Bonanza, barren above Victoria gulch, began its fabulously rich course at the mouth of Victoria gulch. Eldorado, comparatively poor above Gay gulch, began its fabulously rich course just at the mouth of Gay gulch, where I have seen six men shovel \$17,000 into the sluice-boxes in 20 hours, an amount that was by no means exceptional in the late summer of 1898 on No. 36 Eldorado.

Lastly, I should like to know if Mr. Curle has ever seen low-grade quartz, carrying the amount of coarse gold and large nuggets that have been found in Bonanza and Eldorado in two miles of their courses below the mouths of these gulches, and I should like to know of even one auriferous stringer on lower Bonanza.

To write in Mr. Curle's manner is easy. It is easy to impress the Public and the Market. The trouble is to remove the false impression. That can only be done by arduous labour. If Mr. Curle's utterances on West Africa in 1909 are reliable, he surely slandered that country in 1905. If his utterances are proved to be erroneous with respect to the Klondike, it is to be hoped that he will come back and revise his utterances.

WILLIAM CATTO.

Dawson, Yukon Territory,
October 19, 1909.

[This communication has been shown to Mr. Curle, who declines to reply. —EDITOR.]

Counsels of Imperfection.

The Editor :

Sir—The leader in your December issue criticizing Mr. John Hays Hammond's recent address at the Colorado School of Mines appears to merit some protest, lest your readers assume a general acquiescence in your opinions.

To me there have always appeared two points of view with regard to ownership or participation in the finance of mines by mining engineers, which have a bearing on so-called professional ethics. The one view appears to be that the ideal of mining engineering as a profession should be that members hold aloof from all such participation in ownership or finance ; the other is that the evils in the mining business can be more quickly remedied if the whole, or a larger portion of the personnel of the industry, forming the chain between the mine and the capitalist, including directors, promoters, etc., are men of technical and practical training. The latter, I take it, is Mr. Hammond's view, and this opinion he holds in common with many others in the profession, of whom I account myself as one.

I am uncertain whether you adhere strictly to the first view, but I hold that the great majority of mining engineers do not. I have a fairly wide acquaintance among engineers, and I have yet to meet one who does not invest some of his spare money—when he has any—in mines. To say that a man shall be entirely debarred from investment in the one business he knows something about is illogical, and, to my mind, is sufficient answer to this extreme view.

At what point the line in such transactions is to be drawn, that is, upon what occasions an engineer may or may not consistently invest his money, is never difficult to determine for each specific case, and comes down to a matter of common honesty. There can be no objection when such participation does not, either in fact or appearance, conflict with the engineer's independence of judgment, or influence his conduct toward others.

As to the broader ideal, there are thousands of men in this city engaged in various phases of mining and mining finance : promoters, organizers, and directors, who are a necessity to the building up of the industry. It can hardly be contended that these enterprises would not be cleaner and far more ably run if all this entrepreneur class were technically and practically trained in mining itself. Ninety per cent of the evils of the industry arise out of ignorance, and out of the enthusiasm that grows from a lack of knowledge of what constitutes the value of a mine and its proper administration. This being so, how is this class to become endowed with such training unless the young mining engineer is encouraged ultimately to undertake their functions and thereby supplant much of the riff-raff that is at present a necessity to the industry by way of furnishing the demanded personnel ?

The promoter, financier, and director of today are, despite many good and able men, too often of the undesirable type ; but are we to sit down and say that for all future time the world is to endure the present proportion of parasites among this class because no one of a sound mining training is to be allowed, for reasons of hypothetical "professional ethics" to take over their very necessary work of creation and organization ?

You state, in referring to Mr. Hammond : "Next the mentor of the students tells them that he has 'strongly advocated the evolution of the engineer and expert into the 'mining man.' Yes : he has advocated it, but not strongly nor convincingly, and his latest attempt to advocate such views will, we hope, make but few converts. Of all the vague, loose, and objectionable terms for a definitely useful leader of industry commend us to the 'mining man.' This term includes the shareholder and the manager, the metallurgist and the surveyor, the highly skilled and *the least skilled*, the honest operator and *the fraudulent faker, the man who loafs in a mining-town hotel, the 'gent' who presides at the faro* *table, the entire flotsam and jetsam of humanity discarded by the tide of mining speculation*, the captain of industry *and the chevalier d'industrie.*"

I for one cannot agree that it is fair criticism to colour the "mining man" of Mr. Hammond's obvious intent in the terms of the above italics. If you were to omit these italicized words you would come near expressing what Mr. Hammond's auditors would consider his meaning. In this, I believe there is wide accord in the profession.

H. C. HOOVER.

London, December 20, 1909.

The Weight of Learning.

The Editor:

Sir—May I be allowed a little of your space for some matter-of-fact remarks on the weight of learning, using the word 'weight' in its original and concrete sense, being that which gives a permanent set to our book-shelves, wearies our muscles, and costs the engineer unknown sums in excess luggage.

This question is best elucidated by a consideration of tne specific weight of technical literature. The weight per unit of text that the engineer has to store or carry around with him is prodigious and I appeal to publishers to give us our literature with a lower specific weight than they now do. Let me give some examples of light and heavy literature.

Kent's 'Handbook for Mechanical Engineers' contains 21,900 square inches of text in a weight of 23½ oz.; this is equivalent to 932 sq. in. of text for each ounce.

Peters' 'Principles of Copper Smelting' contains 16,200 sq. in. text in a weight of 48½ oz., equivalent to 333 sq. in. per ounce.

Finlay's 'Cost of Mining' contains 11,000 sq. in. text for a weight of 44 oz., equivalent to 250 sq. in. per ounce, and so on.

Stating these in terms of efficiency, based upon Kent as 100%, we have Peters standing at 36%, and Finlay at 27%; in other words, were Peters and Finlay printed on thin light paper and bound in flexible covers, we can fairly say that the one would weigh 18 or 20 oz. in place of 48½, and the other 12 or 14 oz. in place of 44 oz., and this important saving would be accomplished with no change in the typography. This saving of 65% in weight results in practically the same saving in bulk: it is no small matter: statically considered it increases our library space, and saves wear and tear of muscle: kinetically it saves our trunks and boxes, and our pockets as well, or, inversely, allows the peripatetic engineer to reinforce his reference books by 200 per cent.

It is not necessary to enlarge upon these advantages. We have known this comfort in a few cases: J. E. Spurr's 'Geology applied to Mining,' for instance. I know the difficulty of using thin paper for half-tones, but a book like that excellent one of Mr. Finlay's contains no half-tones, and besides, inserts are common.

The practical suggestion is that publishers should bring out a 'Field Edition,' and I feel sure that most engineers would gladly pay a slightly higher price.

R. GILMAN BROWN.

London, December 23, 1909.

The Malm Process.

The Editor:

Sir—In your December issue you give an account of the Malm dry chlorine process for treating complex sulphides, and you say that the older process invented Swinburne and Ashcroft was not a commercial success because it is not easy to replace sulphur by chlorine in practice and because the electrolysis of fused zinc chloride is expensive. I wish to say that the electrolysis of pure anhydrous zinc chloride into chlorine and zinc is not a difficult or expensive operation. With electricity at £10 per kilowatt-year one ton of pure zinc chloride can be decomposed at an entire cost (including depreciation of plant) of £2. 10s. 0d. The decomposition of sulphide ores, according to the Swinburne-Ashcroft method, by a stream of dry chlorine is also neither difficult nor expensive and the reaction is singularly complete and rapid. The conversion of the entire contents of the ore to fused mixed chlorides by this method, with chlorine reckoned free, costs barely 5s. per ton of ore and the sulphur recovered is worth 10s. per ton of ore.

The experiments on a large scale at Runcorn were commercially unsuccessful for the following reasons: (1) The prices charged by the Castner-Kellner Co., £9 per ton of chlorine, and ½d. per kilowatt-hour for current were far too high. (2) The process though easy and cheap in the two main operations, proved expensive and troublesome in the intermediate steps necessary to get rid of the gangue and the iron and manganese contained in the ores treated, which involved dissolving the chlorides in water and re-fusing.

As some improvements have been made recently and as more favourable terms for current can now be obtained, efforts will be continued to make this process a success.

EDGAR A. ASHCROFT.

Sogne, Norway, December 27, 1909.

THE ANANTAPUR GOLDFIELD

THE Anantapur gold field is situated in the Madras presidency, India, and is approximately 100 miles north of the Kolar group of mines. The attention of John Taylor & Sons was drawn to it in 1905, and Thomas Richards, superintendent of the Nundydroog, made a preliminary examination. Subsequent developments have been decidedly encouraging, and the district promises to increase in importance, so that a short account will be of timely interest.

The Anantapur district extends for ten miles and is about one mile wide. There are a great number of ancient workings, indicating that former operations must have been extensive. In some places the workings are from 10 to 20 ft. wide, and the sunken surface can be traced in some instances for hundreds of feet. The accompanying illustration shows one of these workings. The orebodies consist of gold-quartz veins occurring principally in chloritic and argillaceous schists. These schists form the western side of a large mineral belt that extends several miles in length from north to south and in some parts covers a width of four miles. Transport is effected over a cart-road that passes through the centre of the district and meets the Madras & Southern Mahratta railway at Nagasamudram station, which is nine miles distant. Mr. Richards made his first examination in September 1905. He found that the quartz was consistently gold-bearing, and expressed the opinion that prospecting and development were warranted. Accordingly a company called the Anantapur Gold Field was formed with a capital of £30,000, all of which was subscribed in cash and was available as working capital. Subsequent exploration showed that several veins existed, and that they contained gold wherever tested for a distance of seven miles. The most promising results were obtained on the Buruju block, where two prospecting shafts had been sunk midway between two large ancient workings. In the 70 ft. level the vein opened up well, being 3 ft. 5 in. in average width for 100 ft. and assaying 1 oz. per ton. The general developments revealed a consistently wide lode over a distance of 700 ft., and one-third of it contained milling ore, while there were indications of additional shoots both north and south. It was decided to proceed with the active development of this block, and for this purpose the North Anantapur Gold Mines was floated.

The developments at North Anantapur have fully come up to expectations. At the 150 ft. level a wide vein has been opened up for a length of 300 ft., nearly all in milling ore. For 180 ft. the vein is worth 2 oz. for an average width of 4 ft. At several points the vein is 12 ft. wide, and the indications are that other similar rich bunches will be revealed when stoping. In June of this year the developed ore amounted to 6000 tons, and the company therefore bought a 20-stamp battery, which happened to be available in India. The experimental runs with part of this battery show that the ore is amenable to ordinary milling and cyanidation. The shafts have been sunk deeper and levels opened at 250 ft. and 350 ft. Though these levels have not been advanced far, the lode has proved to be well mineralized, and Mr. Richards' opinion is quite favourable.

The original Anantapur company is actively continuing prospecting and development work at three other points on the goldfield. In July at the South Jibutil block the vein in the south winze from the 130 ft. level was found to be a foot wide averaging 2½ oz. per ton, and at the Prospect shaft in the North Jibutil the vein was 18 in. wide and assayed 2 oz. per ton. These two workings are about a mile apart. The South Jibutil is being worked under option by the Nundydroog company with good results, and the purchase of the tract will probably be completed before long. About 1½ miles further north, at the Ramagiri block, a rich strike has been made on the 200 ft. level, where the vein is 9½ ft. wide and worth 1 oz. 7 dwt. per ton.

This gives a general idea of the Anantapur district. Those who are acquainted with the history of the Kolar mines, and know that they were not bonanzas on the surface, are encouraged in their hope of developing a productive goldfield.

Ozokerite is a mineral wax occurring in veins in the vicinity of deposits of bitumen and petroleum. It is found in payable quantities in Galicia and Utah. It is used for making shoe-blacking, artificial bees-wax, insulating material, candles, ointment, and phonograph records. Its colour varies from brown to black, but can be made white by refining. It is lighter than water and melts at a temperature of 50° to 70°C., so can be easily separated from the rock in which it occurs.

ANCIENT WORKINGS AND NEW HEAD-FRAME ON THE NORTH ANANTAPUR MINE.

NOTES

Reducing Oxidized Copper Ores.—F. B. Dick, of Johnson & Sons' Smelting Works, describes in British patent 16,667 of 1908 a method of extracting copper from oxidized copper ores. He crushes the ore fine and subjects it to a red heat in a closed furnace in the presence of coal-gas or other reducing atmosphere for one or two hours. It is then allowed to cool in the reducing atmosphere or in the presence of a neutral gas. The copper is found to be reduced in the form of a fine metallic powder. This is amenable to concentration by means of a flotation process.

Oliver Cyanide Filter.—In the *Mining & Scientific Press* for November 27, A. H. Martin describes the continuous slime-filter in use at the North Star mine, Grass valley, California, invented by E. L. Oliver. The filter consists of a drum revolving on a horizontal axis and partly submerged in the slime. The drum is mounted on a hollow trunnion and is built-up of wooden staves mounted on cast-iron spiders. It contains 24 independent compartments. The filtering medium and an outer canvas covering are bound in place by steel wire. The compartments when immersed in the slime are connected with a vacuum, and for more than three-quarters of their travel are outside of slime. When arriving at a position near immersion the vacuum is cut-off automatically and compressed air introduced, which helps to remove the cake of slime. At the same time a scraper resting on the steel wires carries the cake away. The first filters built were 7 ft. long and 10 ft. diam.; later machines have been made 11 ft. 6 in. diam. and of lengths varying from 7 to 14 ft. The suction of the vacuum is from 22 to 24 in. and the thickness of the cake caused to adhere during the submersion of the surface is from $\frac{1}{4}$ to $\frac{1}{2}$ in. As the cake emerges it is dried to a consistence of about 30% moisture. At a point near the top of the drum the cake is washed by a spray to remove the last traces of dissolved gold. The compressed air has a pressure of 5 lb. The amount of power required for a 100-ton plant is less than 10 h.p.; this serving to provide the vacuum, the compressed air, and the rotation. Four of these filters have been in use at the North Star mine for two years. They have a capacity of 40 to 50 tons each and have been treating a sticky slime free from sand. There are 20 more working in various parts of America and Mexico, with equally satisfactory results and with a high extraction on both low-grade and high-grade slime. At the North Star plant the cost of maintenance for six months, which is the average life of a filter-cloth, was $22·62, and during this time 7200 tons were filtered at a cost of 3 cents per ton.

Graphite in Cyanidation.—It is well known that the presence of graphite in gold ore interferes with extraction, by precipitating the gold from the cyanide solution. The difficulty exists in localities where the ore is in schist, as at Kalgoorlie and at Dharwar. M. W. Von Bernewitz describes in the *Mining & Scientific Press* for December 4 his experience in this connection with the sulpho-telluride ores at Kalgoorlie. Despite much investigation no practicable process has been found for dealing with the problem, and the only course to pursue is to remove as much of the graphite as possible before sending the ore to the mill. At the Kalgoorlie mines the graphite usually occurs on the hanging wall, and the practice is to separate this material, but it is also found disseminated through various parts of the vein, though its presence is not usually detected until that particular ore goes to the mill, when the extraction immediately drops. At the Associated Northern Blocks the ore is dry-crushed, roasted, ground in pans, cyanided, and filtered. The trouble begins in the grinding-pans, for the circulating waters consist of the weak washes from the filter-presses, and contain 0·04% KCy and from $\frac{1}{2}$ dwt. upward of gold. Precipitation of the gold undoubtedly takes place in these pans. The graphite floats to the top as a scum, and this when collected and assayed always shows an appreciable amount of gold. The difficulty is that it is next to impossible to ascertain the amount of graphite in the ore, to tell when it is going to make its appearance, or to catch it all in the solutions. Thus, it is known that precipitation also occurs in the settlers and in the agitators, where the thickened slime is treated with the stronger solutions, but no definite information is obtainable on this point. One of the suggested remedies is to use clean water in the grinding-pans. This, however, means wasting the spent solutions, and this loss would be greater than that caused by the intermittent appearance of the graphite. Another proposal has been to continue the roasting of the ore at a higher temperature so as to burn off the graphite, but this plan is not feasible as the ore would then sinter. The roasting has to be done at a certain temperature, which is below that at which all the graphite can be removed.

MEASUREMENT OF PULP AND TAILING. III.

By W. J. SHARWOOD

Tonnage Crushed in Mills. — This is often estimated merely by count of cars dumped per week or month, and gives at best only a rough approximation to the truth. If a fair proportion of the cars are weighed daily, if moisture samples are taken when the material is not quite uniform in this respect, and if a correction is made periodically for differences in the volume of ore in the storage-bins, the results are reliable within about 2%. A slightly higher degree of accuracy is claimed for the continuous-weighing devices, which are operated by the pressure of a belt-conveyor, and the accuracy of which can be checked by occasionally comparing the record obtained with a carload of ore weighed by reliable scales. When using these devices the corrections for moisture and fluctuations in mill-storage must not be neglected. When "mill time" is used in reckoning tonnage, the time lost in repairs, etc., must be carefully recorded, and the results are reliable only when based on past experience of the average duty performed with a particular ore.

Capacity of Small Crushers.—The capacity of small units, such as five-stamp batteries or Chilean mills, crushing comparatively dry ore, is readily estimated by weighing the ore fed for a few hours. The feed-chute is stopped and the ore weighed in lots of 100 or 200 pounds in a box or barrow on a platform-scale, and thrown into the feeder, a sample being taken for moisture and the proper correction made. A single measurement of this sort should not be used as a basis of calculation for a large installation; for example, in a 100-stamp mill several batteries should be tested and averaged, as variations in wear of castings, in the drop of stamps, in the condition of screens, and in the nature and condition of the ore, may cause differences of fully 25% in the crushing capacity of two similar batteries working side by side on ore from the same bin.

Platform-scales should always be provided with a releasing lever to keep the knife-edges out of contact when not in actual use; without this precaution the sensitiveness rapidly diminishes.

Flow Measurements. — Under this head are included measurements of flowing pulp and of tailing or slime mixed with a considerable proportion of water or solution. The solid material occupies a large proportion of the volume, and the specific gravity of the mixture is greater than unity; these factors introduce complications sometimes overlooked in the computation of tonnage. Several accurate methods of attacking the problem are presented: one depends on the direct weighing of the dried material caught during a measured interval of time; another is based on the measurement of time and the corresponding volume of pulp, together with the specific gravity of the pulp, taking advantage of the relations previously noted between the gravity and solid contents of pulp. Another plan is to estimate the flow of the pulp by means of a weir or any other of the well known devices for measuring the flow of water, and then to determine the weight of solid in a measured volume; this affords a fair approximation when the mixture is fluid enough literally to "run like water." Reduced to the simplest terms the computations from data thus obtained may be made by means of one or other of the following formulas:

FORMULA No. 1: Tons solid per day

$$= \frac{\text{Pounds dry solid caught} \times 43.2}{\text{Seconds observed}}$$

FORMULA No. 2: Tons solid per day

$$= \left(\frac{2700\,d}{d-1}\right) \times \frac{(p-1)}{t}$$

where t is the number of seconds required to yield a cubic foot of pulp,

p = specific gravity of pulp,

d = density of dry solid.

As the expression $\frac{2700\,d}{d-1}$ is constant for any particular material, and the values of it are given under the heading $27\,k$ in Table III., the latter formula may be simplified thus:

FORMULA No. 3: Tons solid per day

$$= \frac{(27\,k)\,(p-1)}{t}$$

which is adapted to calculation at a single setting of the slide-rule.

Since $27\,k$ is a constant when the density of the solid material is uniform, we have in that case only to determine t and p in order to use the latter formula. The specific gravity is readily found, while t may be directly read if we use a measuring vessel of exactly one cubic foot, or it may be simply computed if an exact number of cubic feet are measured and timed. Hence methods based on the observation of gravity are incomparably more rapid and convenient than those depending on the drying and weighing of a sample at each test.

CONSTANTS FOR FORMULA NO. 3.

Density.	Values of k.	Values of $27\ k$.
2·4	171·4	4630
2·5	166·6	4500
2·6	162·5	4390
2·7	158·8	4290
2·8	155·5	4200
2·9	152·6	4120
3·0	150·0	4050

FORMULA NO. 4: Tons solid per day

$$= \frac{\text{Cu. ft. per day} \times \text{lb. dry solid per cu. ft.}}{2000}$$

the number of cu. ft. per day being estimated by weir measurement, etc.

Of the many ways of obtaining the necessary data for computing tonnage by these formulas, the following are suggested as the most practical:

METHOD NO. 1. Turn the whole stream into a portable vessel, such as a galvanized iron wash-tub or sheet-iron tank with handles, and switch out again when nearly full, noting the exact time of catch with a stop-watch. Dry the entire catch in the same vessel and weigh. Use Formula No. 1.

If the wet mixture is also weighed, the water-ratio, etc., can be found, and the tonnage of pulp or water per day is determinable by a similar formula:

$$\frac{\text{Pounds} \times 43·2}{\text{Seconds}} = \text{Tons per day}$$

This is available for a small or medium flow, up to about the capacity of a 10-stamp mill. The vessel should hold at least 20 seconds' flow, and preferably the output of a minute or more.

METHOD NO. 2. This involves two stages:

(A) Relation of time and volume. Turn the whole stream into a rather large vessel, switch it off after as long an interval as convenient, noting the exact time. Measure the volume and calculate t = seconds for one cubic foot flow. This measurement may be simplified by graduating the vessel by means of rivets or small bolts projecting inwards, at several points indicating exact cubic feet, and stopping the watch at one of these marks. With a 'split-second' watch several such readings may be made and averaged during a single filling. A cylindrical vessel is preferable; an acid-drum answers well. Time of filling should not be under 20 seconds.

(B) Relation of volume to weight. Catch an average sample of the pulp in a vessel that admits of measuring the volume with a fair degree of accuracy. The volume taken must depend on the accuracy with which the residue is to be weighed: if to the nearest ounce, at least a cubic foot is taken; if to one gram, 1000 c.c. may suffice. Dry and weigh the residue, and calculate the number of dry pounds per cubic foot of pulp.

$$\frac{\text{lb. per cu. ft.} \times 43·2}{t} = \text{Tons solid per day.}$$

By also weighing the wet mixture caught, the water-ratio, tonnage of pulp and water, etc., can be computed.

METHOD NO. 3. (A) Determine the value of t exactly as in Method No. 2.

(B) Catch a moderate-sized sample of average pulp in a bucket. Weigh without noting volume, dry and weigh solid residue. Calculate S = percentage of solid in pulp. Calculate gravity of pulp by the formula:

$$p = \frac{k}{k - S}$$

the value of k depending on the density of the dry solid, which must be known or determined (see Table III). Then apply Formula No. 3 above. As the value of p has been found, the water ratio and other factors can be calculated or read from a curve at once.

METHOD NO. 4. (A) Determine the value of t exactly as in Method No. 2.

(B) Determine the specific gravity of pulp (p) directly in a special sample, either by the gravity flask, or, if practicable, by the hydrometer. Apply Formula No. 3. If the stream tested is large several determinations of p should be made and averaged.

METHOD NO. 5. Single measurement system, adapted for small or medium flow. A suitable bucket is graduated to hold exactly 1, 2, or 3 cubic feet; this is done by weighing in it 62·5 lb. water, or the proper multiple of this weight. Hold this under the stream, or turn the entire stream into it, and switch out as soon as full to the mark, noting the exact time of filling. Weigh the catch and calculate the gravity:

p = total pounds pulp per cubic foot × 0·016

The value of t (= seconds for *one* cubic foot) is known from observation. Apply Formula No. 3. One man can operate a single cubic-foot bucket; three cubic feet is the largest that can be handled by two men.

Method No. 6. A modification of Method No. 5, simplifying computation, is to have a bucket with two marks, one at a point corresponding to exactly one cubic foot or 62·5 lb. water, the other 1·60 cu. ft. or 100 lb. water. The watch is stopped at the cubic foot graduation, but the stream is not diverted until the 100lb. mark is reached. The weight in pounds then gives gravity directly without calculation. By stopping the stream just short of the 100-lb. mark, and then adding small amounts of pulp with a dipper until it is just reached, a little closer approximation to the true specific gravity is obtained than is possible when working with the stream alone.

Comparison of Calculated and Actual Volumes (see Method No. 7).

	Theoretical efflux of water, relative volume.	Actual efflux of water.	Total efflux of pulp.	Volume occupied by sand.	Ratio by weight water / solid
Free outflow	100	103·5	118·5	15·0	2·3
,, ,, ...	100	97·0	112·5	15·5	2·1
,, ,, very thick ...	100	103·5	152·5	49·0	0·7
,, ,, ...	100	101·0	109·0	8·0	4·2
Flow obstructed by elbow	100	89·0	104·0	15·0	2·0
Obstructed by water inlets	100	92·5	117·5	25·0	1·2

These results are remarkable as indicating that the addition of a very large proportion of sand to water has very little effect on the rate of flow of the water itself through a nozzle.

Method No. 7. Measurement by weir, etc. Measure the flow by means of a weir or similar device, calculating the result to cubic feet per day by the usual formulas given in the various engineering pocket-books. Obtain the weight of solid per cubic foot either by a gravity method or by drying a measured volume. With thin fluid pulp this gives quite accurate results, but if thick it is less reliable. Unfortunately there is but scant information available as to the laws governing the flow of water charged with solids over weirs or through orifices.

Results obtained by computing the flow from orifices and nozzles by formulas adapted to clear water are modified when the percentage of solid is sufficient to materially increase the gravity. In a number of careful measurements of pulp containing large proportions of sand and issuing from nozzles at the apexes of inverted cones, the volumes of water passing were very nearly those calculated by the standard formulas, assuming the efficiency of the orifice as 100 per cent.; while a large amount of sand passed out in addition to the water, in some instances the weight of sand being considerably greater than that of the water. In the accompanying tabular comparison the four last columns of figures are values found in a series of tests conducted in connection with classification of sand by A. J. Clark, to whom I am indebted for the data' while the theoretical efflux was based on a spouting velocity of $8\sqrt{H}$ ft. per second, H being the head in feet, the efficiency of orifice being taken at 100 per cent.

When a tank or settler is interposed in the line of flow it is sometimes possible to cut off either the inlet or outlet and observe the rate of fall or rise of the surface by a hook-gauge and stop-watch, thus obtaining an absolute value of the volume per second: if the fall is measured the surface must not be allowed to drop enough to diminish the effective head appreciably.

As examples of measurement and computation we may take the following instances involving Methods No. 1 and 5, which give a fair idea of the agreement of the more rapid methods with that based on drying a large sample. Time-samples were taken at 4-hour intervals from the thick and slightly variable discharge of a tube-mill by means of a 5-gal. bucket; these were weighed and the rates of discharge, expressed in tons per day, were read

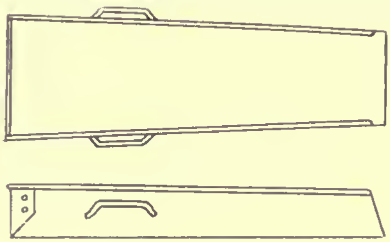


FIG. 3.

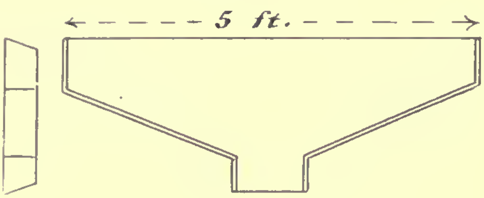


FIG. 4.

from a table (C, at end of this paper) based on Method No. 5. To check the accuracy of these readings each sample was thrown into a sheet-iron tub and allowed to settle, the clear water was drawn off and after 24 hours the solid matter was dried and weighed. The density of the ore was 3·0.*

EXAMPLES OF COMPUTATIONS.

Shift.	Weight of 2/3 cu. ft. (5 U.S. gal.) lb.	Seconds for 2/3 cu. ft.	Dry tons per day from table.	Water Ratio.	Specific Gravity.
1	69·5	25·0	72·1	0·665	1·668
	69·5	24·0	75·1	0·665	1·668
2	69·75	26·0	70·0	0·656	1·675
	68·0	25·2	67·5	0·72	1·632
3	68·5	25·6	67·8	0·70	1·644
	68·0	24·0	71·1	0·72	1·632
I Mean of 6 measurements			70·6	0·69	1·653

Total time of sampling .... 149·8 seconds.
Dried sample, direct weighing ...... 247·0 pounds.

II By Formula No. 1 : $\frac{247 \times 43 \cdot 2}{149 \cdot 8} = 71 \cdot 1$ tons per day.

As an instance of direct computation from observations by Formula No. 3 without using a special table we may take the data of the first sample. Since 2/3 cu. ft. weighs 69·5 lb., the gravity of pulp is $69 \cdot 5 \times 1 \cdot 5 \times 0 \cdot 016 = 1 \cdot 668 = p$; and $p - 1 = 0 \cdot 668$. For $d = 3$, the value of $27\ k$ is 4050 (Table III). Since 25 seconds fills 2/3 cu. ft. the time for 1 cu. ft. = $37 \cdot 5 = t$. Then

$$\frac{27\ k\ (p-1)}{t} = \frac{4050 \times \cdot 668}{37 \cdot 5} = 72 \cdot 1 \text{ tons per day.}$$

COMPARISON OF METHODS.

Obviously some of these methods are better suited to particular conditions than others. In any case a system should be selected, or vessels proportioned, so that the time observed by the stop-watch is not much under 20 seconds; a minute or more would be preferable. The accuracy attainable increases directly with the time of observation : under the most favourable conditions, using a watch indicating fifths of seconds and neglecting personal equation, a percentage error of between $\frac{40}{\text{seconds flow}}$ and $\frac{20}{\text{seconds flow}}$ may be due to the two time-observations made at starting and stopping. For instance, with a reading of approximately 10 seconds, the error from this source may be between 2 and 4%, but by making the time 100 seconds it may be reduced below 0·4%. For rapid approximations, using Method No. 4 or No. 5 with a bucket of 1 or 2 cubic feet, 10-second periods are allowable.

Method No. 1 gives excellent results when the time of observation can be made long enough. Its disadvantage is the length of time required to dry a large sample, even when the greater part of the water is removed by settling and siphoning. Heat is required for the drying, and a considerable area of heating surface is necessary when large samples are taken. For this reason Methods No. 2 and No. 3 are preferable since a smaller amount is dried. Methods No. 4, No. 5, and No. 6 are rapid, and suited to all ordinary work, especially the control of single units, such as small batteries, pans, or concentrators. They are at a disadvantage however if the density of the ore fluctuates greatly ; in this case Methods No. 2 and No. 3 are to be recommended.

If the density of the dry material is nearly constant, and frequent measurements are desirable, it is advisable to draw up a table covering the readings usually observed : at the head of the vertical columns is given either the gravity or the number of pounds of pulp per cubic foot, the seconds per cubic foot at the left of the horizontal rows ; the tons of solid per day are entered at the corresponding intersections, as in Tables B, C, and D.

Even if the gravity methods were less accurate as regards a single observation, they would give more accurate results in many cases than the first method described, provided two or three were taken at intervals during the day and averaged ; the time occupied in drying usually precludes repeated determinations by Method No. 1. It must be remembered that any flow - determination is usually instantaneous, or at least represents a period

* These data were furnished by A. J. Clark. He prefers to use a container graduated to hold only 5 U.S. gals. or 2/3 cu. ft., as being more easily handled by one man than a full cubic foot, when sampling heavy material. Table C at end of this paper is a portion of one computed on the 5-gall. basis. The weight in pounds multiplied by 0·024 gives specific gravity.

A

TONS OF SOLID SLIME IN AGITATOR

Marysville, Montana.

Density of Dry Slime = 2.60

Average level of pulp is read with respect to datum-mark on staves, Specific gravity of pulp is determined by weighing 1000 c.c. ; total tons dry slime in agitator read directly from table, interpolating.

Upper datum-mark = 420 Fluid Tons
Lower " " = 310 " "
ONE INCH = 3 " "

SPECIFIC GRAVITY OF PULP	WATER RATIO	SOLID FACTOR FOR 100 TONS	TONNAGE OF DRY SLIME — When capacity of vat to same level in Fluid-tons 420	410	400	390	380	370	360	350	340	330	320	310	300
1.268	1.9	43.8	184	179	175	171	166	162	157	153	149	144	140	136	131
1.257	2.0	42.0	176	172	168	163	159	155	151	147	143	138	134	130	126
1.247	2.1	40.3	169	165	161	157	153	149	145	141	137	133	129	125	120
1.238	2.2	38.7	163	139	155	151	147	143	139	136	131	127	123	120	116
1.229	2.3	37.3	157	154	150	146	142	138	134	130	127	123	119	115	112
1.220	2.4	36.0	151	147	144	140	137	133	129	126	122	119	115	112	108
1.213	2.5	34.7	145	142	139	135	132	128	125	121	118	114	111	107	104
1.206	2.6	33.5	140	137	134	130	127	124	120	117	114	110	107	103	100
1.200	2.7	32.4	136	132	129	126	123	119	116	113	110	106	103	100	97
1.193	2.8	31.4	132	128	125	122	119	116	113	110	106	103	100	97	94
1.187	2.9	30.5	128	125	122	119	116	112	109	106	103	100	97		
1.181	3.0	29.6	124	121	118	115	112	109	106	103	100	97			

B

TONNAGE TABLE FOR FIVE STAMPS

.Density of Ore = 3.0

Pulp is run into cylinder holding 15 U.S.gallons (2 cu.ft.) & weighed on platform scale: time for 2 cu.ft. is taken with stop-watch. Value in last column divided by SECONDS = TONS PER STAMP PER DAY

Net Weight of 2 cu.ft. Pulp Lb .Avp .	Specific Gravity of Pulp	Water Ratio	Tons per Stamp per 24 hours, if 2 cubic feet caught in ONE SECOND
131.50	1.052	12.40	84.3
0.675	1.053	12.22	86.0
0.75	1.054	12.00	87.5
0.875	1.055	11.79	89.1
132.00	1.056	11.57	90.8
0.125	1.057	11.36	92.4
0.25	1.058	11.155	94.1
0.375	1.059	10.96	95.7
132.50	1.060	10.775	97.2
0.675	1.061	10.59	98.8
0.75	1.062	10.42	100.4
0.875	1.063	10.25	102.0

TABLE VII

SLUICING DATA

BASED ON WET SLIME-CAKE OR RESIDUES CONTAINING 33.33 PER CENT WATER (M = .50 C = 66.66)

	DENSITY OF DRY SOLID	SPECIFIC GRAVITY OF FINAL PULP = p = HYDROMETER READING ***												
		1.01	1.03	1.05	1.07	1.10	1.15	1.20	1.25	1.30	1.35	1.40	1.45	1.50
VALUES OF Q = TONS WATER ADDED PER TON OF DRY SOLID IN WET CAKE OR RESIDUE SLUICED = R — M	2.4	57.4	18.5	10.75	7.41	4.92	2.98	2.0	1.417	1.026	0.750	0.542	0.380	0.250
	2.6	60.7	19.6	11.4	7.90	5.27	3.22	2.19	1.575	1.166	0.873	0.654	0.483	.346
	2.8	63.5	20.6	12.0	8.33	5.57	3.42	2.36	1.715	1.286	0.98	0.75	0.571	.429
	3.0	65.8	21.4	12.5	8.68	5.83	3.61	2.50	1.833	1.389	1.072	0.833	0.648	.500
TONS WATER ADDED PER TON OF WET MATERIAL SLUICED $T = \frac{Q\ C}{100}$	2.4	38.3	12.3	7.17	4.94	3.28	1.99	1.33	0.945	0.684	0.500	0.361	0.253	.167
	2.6	40.5	13.0	7.60	5.27	3.51	2.15	1.46	1.05	0.778	0.582	0.435	0.322	.231
	2.8	42.3	13.7	8.0	5.55	3.71	2.28	1.57	1.14	0.858	0.654	0.50	0.381	.286
	3.0	43.9	14.3	8.33	5.79	3.89	2.41	1.67	1.22	0.926	0.715	0.555	0.432	.333
TONS WATER ADDED PER CUBIC FOOT OF WET MATERIAL SLUICED **	2.4	1.96	.630	.351	.252	.168	.102	.068	.0485	.0350	.0256	.0185	.0130	.0086
	2.6	2.146	.689	.403	.279	.186	.114	.077	.0557	.0412	.0304	.0231	.0171	.0122
	2.8	2.315	.750	.438	.305	.203	.125	.086	.0624	.0469	.0357	.0273	.0208	.0156
	3.0	2.470	.805	.470	.325	.219	.136	.094	.0686	.0522	.0402	.0312	.0243	.0167
EFFICIENCY OF SLUICING = E = TONS DRY SOLID MOVED PER 100 TONS OF ADDED WATER $= \frac{100}{R - M}$	2.4	1.74	5.40	9.3	13.5	20.3	33.6	50.0	70.5	98.3	133.	184.	263	400
	2.6	1.65	5.10	8.77	12.7	19.0	31.0	45.7	63.5	85.7	114.	153.	207	289
	2.8	1.575	4.78	8.33	11.6	18.0	29.2	42.4	58.3	77.7	102.	133.	175	233
	3.0	1.52	4.67	8.0	10.7	17.1	27.7	40.	54.5	72.0	93.	120	154	200

** Assuming material compacted so that interstices are full of water. *** p = pounds per cubic foot X 0.016 .

TABLE VIII

SPECIFIC GRAVITY AND WEIGHT PER CUBIC FOOT OF WET CAKE OR RESIDUE

MOISTURE RANGING FROM 25 TO 40 PER CENT

Data for constructing tables similar to Table V
for material differing in moisture content.

Material compact so that interstices are full of water.

MOISTURE IN CAKE OR RESIDUE SLUICED PER CENT	VALUE OF C PER CENT SOLID	VALUE OF M WATER RATIO	DENSITY OF DRY SOLID d	SPECIFIC GRAVITY OF WET MATERIAL	WEIGHT OF WET CAKE PER CUBIC FOOT POUNDS	WEIGHT OF DRY SOLID PER CUBIC FOOT OF WET CAKE POUNDS
40.0	60.0	0.6667	2.4	1.538	96.15	57.69
			2.6	1.585	99.08	59.45
			2.8	1.628	101.74	61.05
			3.0	1.667	104.17	62.50
35.0	65.0	0.5384	2.4	1.610	100.67	65.43
			2.6	1.667	104.17	67.71
			2.8	1.718	107.36	70.08
			3.0	1.765	110.30	71.70
33.33	66.67	0.50	2.4	1.636	102.27	68.18
			2.6	1.696	106.0	70.66
			2.8	1.750	109.38	72.92
			3.0	1.80	112.50	75.0
30.0	70.0	0.4286	2.4	1.690	105.63	73.94
			2.6	1.756	109.69	76.83
			2.8	1.820	113.75	79.62
			3.0	1.875	117.19	82.03
25.0	75.0	0.3333	2.4	1.778	111.11	83.33
			2.6	1.857	116.06	87.05
			2.8	1.931	120.7	90.53
			3.0	2.00	125.0	93.75

not exceeding a minute or two, which may be far from the average flow of the entire day when the various adjustments of a mill or concentrator are considered. Several rapid and fairly approximate determinations, at more or less regular intervals during a day and averaged, are preferable to a single observation made with all possible precautions and carried out with scientific accuracy, if the sample taken in the latter case is subject to momentary variations. As a matter of fact the gra-

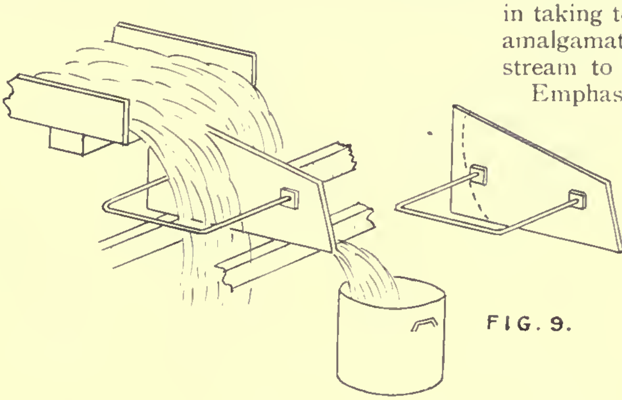


FIG. 9.

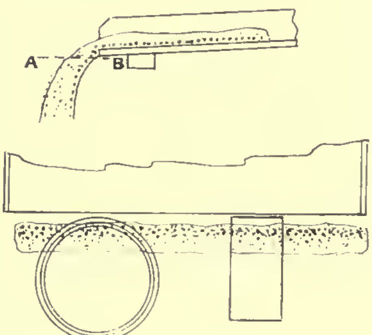


FIG. 5.

vity methods are almost, if not quite, as accurate as the system of drying the entire sample, provided that the density of the dry material is known within small limits, and that the pulp is not extremely thin. Variations of heat in drying large samples introduce far greater errors than are commonly realized. When the tailing contains clay or other hydrous silicates, errors amounting to several per cent. may be made if the heating is carried too far; while one or two per cent. of actual moisture may be left in a residue by drying at too low a temperature.

A stop-watch can be purchased for less than five dollars, sufficiently accurate for the work described. It should be occasionally tested by 5-minute comparisons with a watch known to keep correct time. For timing periods of over two minutes an ordinary watch usually suffices.

For diverting a stream into a measuring vessel a sheet-iron trough or short launder (Fig. 3), up to about 3 ft. long, is often convenient, one end being closed; this can be rapidly thrust in or out of the stream. A wide and shallow sheet-iron chute (Fig. 4) is useful in taking tonnage samples at the foot of an amalgamating sluice, as it brings the wide stream to a narrow outlet.

Emphasis must be placed on the necessity, in sampling a flowing stream, of not merely sampling every portion of the cross-section but of sampling each portion for an equal period of time, so far as possible. It is important to recognize the tendency of the coarser particles to become segregated or concentrated in certain portions of the stream; this tendency is shown diagrammatically in Fig. 5, 6, and 7, which are idea-

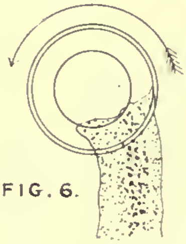


FIG. 6.

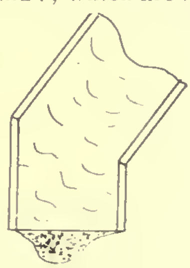


FIG. 7.

lized from actual observation in making sizing tests. In such non-homogeneous streams the samples taken will not be truly representative unless the sampler is parallel-sided and moved at uniform speed across the stream so as to cover the entire cross-section.

Fig. 5 shows the tendency of large and heavy grains to hug the bottom of a sluggish stream; the lower view represents a horizontal section in the plane AB; it is obvious that a round dipper or similar vessel, held so as to reach just through the underside of the falling pulp, will take a sample in which the coarser sand is not fully represented. This condition is met in sampling at the foot of mill sluices and slow-flowing launders. The sheet-iron chute shown in Fig. 4 can be thrust quickly under the lower end of a plate-table to convey the entire flow to a measuring-bucket.

Fig. 6 shows the outlet end of a tube-mill, and Fig. 7 (plan) segregation in a crooked launder.

The tipple device illustrated in Fig. 8, permanently built in connection with the amalgam-trap at the foot of a sluice or in similar positions, carries the flow through a narrow outlet, so that the whole stream can be caught in a relatively small vessel. In taking a time-sample this tipple is easily manipulated with one hand while the stop-watch is held in the other. Where such a device cannot be permanently inserted, owing to insufficient fall, the use of a slotted pipe or parallel-sided cutter is to be recommended for sampling moving pulp, either for assay, gravity, or sizing-tests. For time-tests it is of course essential that the entire flow, or a precise aliquot part of it, should pass into the measuring-vessel throughout the period tested.

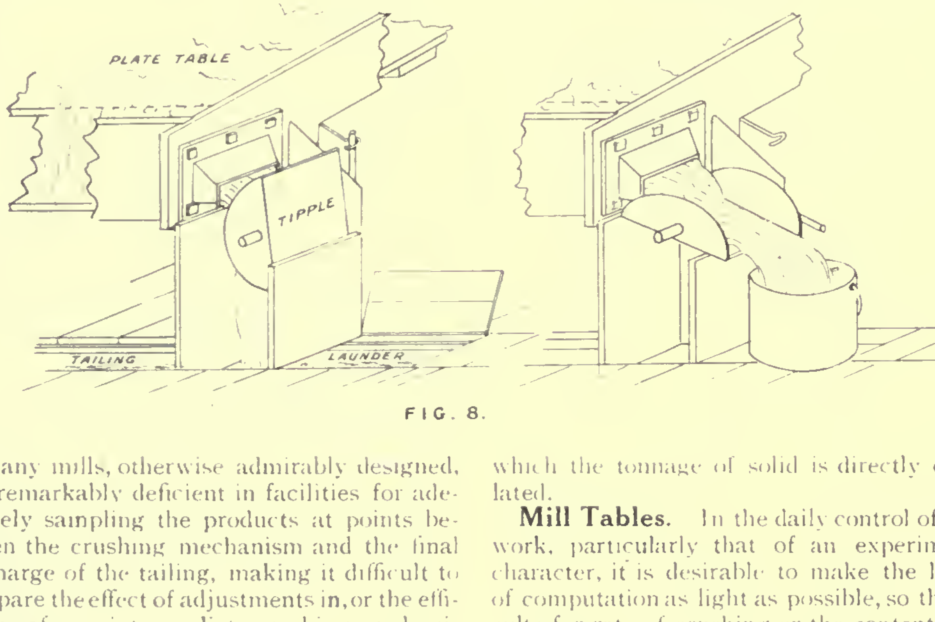


FIG. 8.

Many mills, otherwise admirably designed, are remarkably deficient in facilities for adequately sampling the products at points between the crushing mechanism and the final discharge of the tailing, making it difficult to compare the effect of adjustments in, or the efficiency of, any intermediate crushing or classifying units.

Measurement of Large Tonnage. When the flow is heavy it may be impossible to catch the entire stream for a sufficient period to get an accurate time measurement. If this stream is made up of several feeders it may be possible to estimate each of the tributary streams separately and take the sum of their tonnages. If the stream pours at any point from a wide launder it is sometimes practicable to use a cutter (Fig. 9), made with deep parallel sides of stiff sheet-iron, sharpened at the upper edge, the width being an aliquot part of that of the main launder. For instance, if the launder is 30 in. wide, we can divert one-fifteenth of the entire flow by using a cutter 2 in. wide, which is moved uniformly backward and forward across the full width of the stream, so as to convey an average sample to the measuring drum. In such a case two or more determinations should be made and averaged, both of time and of gravity or water ratio, owing to the tendency of particles of various sizes to segregation.

If the water flow is constant, as is the case in some mills, this can be determined once for all (as for instance by a weir-measurement of the flow to the mill, or by the fall per minute of the surface in the mill feed-tank when the supply is shut off). The water tonnage being thus found, determinations are made from time to time of the ratio of water to solid in the pulp, either directly or from its gravity, from which the tonnage of solid is directly calculated.

Mill Tables. In the daily control of mill-work, particularly that of an experimental character, it is desirable to make the labour of computation as light as possible, so that results for rate of crushing or the contents of a vat can be read off rapidly after making the required observations by weighing pulp, etc. For this reason it is convenient to have a suitable table prepared to meet any special case, and an hour or two spent in making such a table will be saved many times over in subsequent work when systematic experimentation is carried on. A few examples of such tables are shown.*

* A comprehensive table for Rand sand and slime, by W. A. Caldecott, is to be found in the *Journal* of the Chemical, Metallurgical and Mining Society of S. Africa for October 1908, and others appeared in the issue of October 1904, and *Proceedings*, Vol. II, page 374.

STEEL INDUSTRY IN THE TRANSVAAL

By DONALD F. CAMPBELL

THE establishment of an iron and steel industry in the Transvaal would be welcomed by mining engineers because it would tend to reduce the cost of mining, not only by a possible diminution in the price of the steel used underground, but by improvement in quality. At present the quantity of drill-steel annually imported into the Transvaal is from 5000 to 5500 tons, which is sold at a price varying from £30 to £35 per ton. This is shipped principally from England, but considerable competition from American, German, Swedish, and Belgian manufacturers is felt. As a result, prices are lowered and inferior qualities of steel are put on the market.

The best steel for drilling was formerly made in the crucible, but gradually this has been replaced by Swedish bessemer, English bessemer, and even open-hearth steel. Swedish bessemer is steel made in the converter from Swedish raw materials, which are remarkable for their low sulphur and phosphorus contents. A similar material is made in England from equally pure materials, but owing to the enhanced value of any steel to which the mystic word 'Swedish' is attached, this epithet is retained in the case of many steels that are not derived in any sense from the Scandinavian peninsula. The use of Swedish raw material in making high-class steel is generally supposed to give certain definite good qualities and 'body.' What 'body' is, has not been accurately determined, and the cause is equally obscure. The Sheffield steel-maker of the old school attaches the utmost importance to this mysterious property, which he attributes to his Swedish ingredients, but it is probable that he under-estimates the value of his long experience in the melting and subsequent treatment, often the result of several generations of careful observation, and that it is to this, and this alone, that the property of 'body' is due, provided suitable raw material be used.

Steel, equal to the best Sheffield bars, could be made in the Transvaal by the electric furnace. This produces an intense heat, permitting of the most basic slags; as a result, common scrap, such as is found in large quantities in South Africa, can be melted and refined to a steel of crucible quality. The establishment of this industry would not only provide a steady market for scrap-iron and steel, but would also enable the mining and railway companies to obtain first-class steel castings at short notice. The success of this industry appears to depend on the use of an electric furnace, as this is the only means by which common scrap can be economically refined to produce high-class steel. In the case of any other process about 30% of pig-iron must be imported or made, otherwise complete refining cannot be effected. In Europe and America there are several electric furnaces in use. It is interesting to note that a company controlling the process most generally adopted for electric steel-refining by American and English firms has already sent engineers to South Africa with a view to the establishment of this industry, while the Transvaal Government has sent representatives to visit the principal works in Europe, where electric steel-making is established.

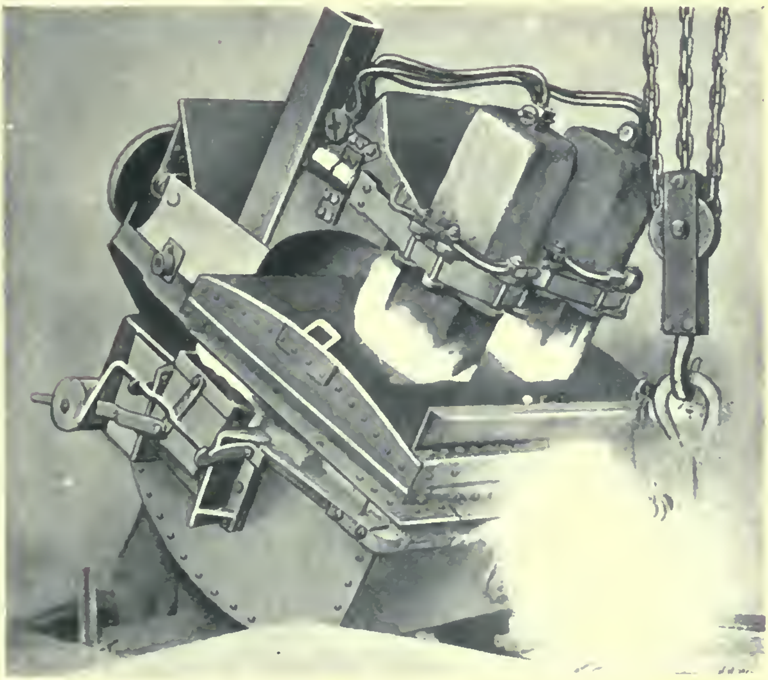
The mining companies will profit in two ways: by obtaining better steel and by having a ready market for their scrap steel, the price of which during recent years has only been from 5s. to 7s. 6d. per ton, while the quantity exported during the last two or three years has amounted to 40,000 tons.

The possibility of starting blast-furnaces for the manufacture of pig-iron is being investigated carefully, and also the question of export. It will be impossible to export pig-iron to Europe under present conditions of labour and supplies. The export trade would have to compete with such producers as the Dominion Iron & Steel Co. or the North of England blast-furnaces, where excellent ore and coal are available on the sea-coast, together with efficient labour. The deposits of iron ore in the Transvaal are undeveloped, and though the outcrops are large, the composition of the ore in depth is unknown, coal of suitable coking qualities is not widely distributed, while the labour and transport conditions alone present serious difficulties for the successful establishment of this industry.

There remains then only the possibility of pig-iron manufacture for local use. Rail-mills cannot be worked economically on small outputs. The market for foundry-iron is comparatively small and largely fed by scrap cast-iron, which sells at about 80s. per ton. The only considerable items on the import list of iron and steel are large quantities of corrugated sheet-steel. The possibility of erecting a small Swedish blast-furnace to supply a small mill to make sheets and rails is under consideration. These might be made economically, if a thorough investigation proves all the conditions favourable, but at present the only industry that can be deemed profitable is the refining of scrap-iron and steel in the electric furnace.

South Africa is essentially a market for high-grade steel. Of the iron and steel imports, which have a value of about a million sterling, there are 5500 tons of mining bars and an equal tonnage of shoes and dies, of a value of over £250,000. Small railway-castings, axles, and crusher-jaws could all be made profitably, provided a suitable quantity of iron and steel scrap be available at a reasonable price. This industry should prove beneficial to the mining community, the power-supply companies, and the promoters; incidentally improving the quality of steel used on the Rand and preventing the wasteful export of scrap, which is part of the undeveloped wealth of the country and should not be allowed to go elsewhere.

Extreme care must be exercised in the choice of the locality in which the first blast-furnace is erected. Coking coal exists in the Middelburg district and also iron ore, both titaniferous and good hematite. It remains to consider the effect of the proposed improvements intended to make Delagoa Bay the principal port of South Africa and the possible influx of Indian labour into the adjacent Portuguese territory. Africa is in a stage of transition. United South Africa has internal and international questions of the utmost importance before her, and not the least important is the future of Delagoa Bay and the surrounding territory. Steel-works designed to make a small tonnage of high-class material require an expenditure of less than £100,000, and Johannesburg alone provides a market, but blast-furnaces and rail-mills involve some hundreds of thousands of pounds, as well as questions of wide and international importance. After the smaller industry is firmly established, it will be quite soon enough to consider possible expansion.



Electric Steel Furnace, using the Froges-Heroult Process, at La Praz, Pouring Molten Steel.

The subject is of the greatest practical importance to the industrial stability of the Transvaal. Iron is the bread of commerce and steel is the staff of industry.

TREATMENT OF COMPLEX SULPHIDES

By DONALD CLARK

E. J. HORWOOD, of the Broken Hill Proprietary, recently patented a process for separating zinc sulphide from other sulphides. The ore is subjected to a roast at a low temperature, whereby the particles of iron and lead sulphides become coated with oxide or sulphate so as to be 'deadened' to the next step in the process, which is to agitate them with a hot dilute solution of sulphuric acid and a small quantity of oil. The sulphide of zinc floats, and the deadened compounds and gangue sink. After a year's experimental work in the laboratory, Mr. Horwood erected a trial plant at the Bendigo School of Mines, Victoria, capable of dealing with one ton per hour. The results obtained with Broken Hill slime concentrate and the zinc-lead-iron sulphides of the West Coast of Tasmania have been highly satisfactory.

Roasting is done in an Edwards tilting furnace 35 ft. by 8 ft. 6 in. As the heat has to be kept low the charge is not allowed to come too close to the fire-end of the furnace, a low bridge being built to confine the ore to the front part of the furnace and the last two rabbles are placed out of action. The roasting-area is thus reduced to 20 ft. by 6 ft. When Broken Hill slime - concentrate was treated, the charge weighed 27 cwt. and was 3 in. deep. The slime contained 32% zinc and 22% lead, and the time occupied in roasting was 3 hours. The temperature of the gases reaching the ore is kept between 300° and 350° C. At this temperature the charge only glows in the dark.

When treating other ores than Broken Hill slime, crushing must be carried far enough to free the individual particles of mineral; in most cases this means sliming the product. Care has to be taken to ensure that no lumpy products are fed into the furnace, as these become kernel-roasted and the blende may become sulphatized.

The subsequent treatment follows that successfully practised at the Central mine, Broken Hill, by the Minerals Separation's process. The charge is added to a hot dilute solution of sulphuric acid, and a small amount (two to three pounds per ton) of oleic acid is then added and the mixture passed through a series of agitators. Air is churned into the mixture by this operation. The pulp then passes into a spitzkasten, where the sulphide of zinc rises and forms a thick scum that floats away, while the gangue and deadened products sink. These products pass into a second spitzkasten and finally through a third, from each of which the overflow carries some floating sulphide. The zinc sulphide passes into a common shallow launder and the cooling of the liquid facilitates the coagulation of the sulphide particles into small lumps. These settle rapidly in a box provided with baffles, and the muddy solution which carried them over from the spitzkasten flows to a storage-vat. By re-agitating and refloating the sulphide in clear spent solution a high-grade zinc concentrate is obtained. The last product containing the lead residue is settled and the clear hot solution flows back to the main solution sump, which is kept hot by steam injection.

No estimate is as yet available relating to the cost of roasting, but the flotation will cost from 6s. to 10s. per ton and a flotation-plant to treat 10 tons per hour will cost about £3000.

The success of the process depends on the ability to maintain an even temperature in the furnace. Everybody who has worked a furnace knows the practical difficulties in the way of keeping the heat within bounds. A careless, sleepy, or indifferent workman can easily spoil the whole process. If the material has been over-roasted, not only will there be a loss of zinc but there will be an increased consumption of acid in the flotation process, and these two losses may easily upset all calculations.

Bulk tests have given results closely agreeing with those obtained in the laboratory: hence the suitability of an ore for the process can readily be determined. Tests have been made by Messrs. Bradford and Henderson, chemists to the Broken Hill Proprietary. The ore is crushed to pass through a 100 to 150-mesh sieve according to the nature of the ore. The following instructions will show whether the ore is amenable to the process:

Take about 50 grammes and roast on an iron dish over a gas flame, stirring well all the time; the bottom of the dish may be at a dull red, but the ore must not become red hot. The time taken is from 1½ to 3 hours. The amount of lead sulphatized is found by taking one gramme of ore. Digest in 30 c.c. ammonium acetate, sp. gr. 1·75. Boil five minutes. Filter and titrate with ammonium molybdate.

MINERALS SEPARATION PLANT USED IN HORWOOD'S EXPERIMENTS.

(1) Elevator. (2) Agitators. (3) (4) (5) Spitzkasten.

(6) Launder for concentrate. (7) Settler for concentrate. (8) Sump for lead residue and gangue. (9) Solution Sump.

Salts of iron interfere with the end reaction at first, but toward the completion of the roast, iron does not go into solution. Usually, if from 50 to 75% of the lead is sulphatized very little will float; the unaltered lead sulphide becomes encrusted with a coat of sulphate and is thereby deadened. The zinc oxidized or converted into basic sulphate is determined by taking one gramme of ore; digest with 100 c.c. of 1% sulphuric acid for 10 minutes at boiling point, filter, oxidize with 3 c.c. nitric acid, add 7 gm. ammonium chloride, 15 c.c. strong ammonia, then 1 gm. sodium peroxide; oxides of iron and manganese are thus precipitated. Wash with 1% ammonium chloride solution and continue washing until the bulk is 300 c.c.; then add 7 gm. bitartrate of potash, then four drops of a 10% solution of ferric chloride. Titrate with potassium ferrocyanide, using glacial acetic acid as indicator.

Zinc should not pass into solution; overheating during roasting is the main cause of the sulphatization of the blende. Any zinc that becomes oxidized is lost in the solutions, and causes the further drawback of increasing the consumption of sulphuric acid.

The amount of acid required is determined by taking 25 gm. ore and digesting in 200 c.c. of a 1% sulphuric acid solution at 100°C. The solution is then filtered and measured without washing. An aliquot portion is taken and the acidity determined. This test is found to be more drastic than is required on a working scale, sometimes 30% less acid is actually used than that indicated.

The flotation test is made by taking a 500 c.c. stoppered cylinder, adding 250 c.c. boiling water to 50 g.m. roasted ore, then 2 to 3 c.c. sulphuric acid, sp. gr. 1·8. Mix the whole quickly by shaking two or three times, then add 0·1 to 0·2 c.c. oleic acid; replace the stopper and shake violently for a few minutes. Allowed to stand, the sulphides rise rapidly to the surface and the gangue and residual lead products sink. If the cylinder is provided with an outlet near the base the gangue can be drawn off into one vessel and the sulphides into another, and if necessary re-floated and agitated: or the contents of the cylinder may be emptied into a cylindical beaker and heated, the sulphides again rising, and these may be skimmed off with a spoon or a strip of fine wire-gauze.

In the next column are given some typical results obtained in the laboratory and afterward on bulk parcels in the experimental plant. These indicate the value of the process. The tests were not confined to Broken Hill slime, but were also conducted on various troublesome Tasmania ores, as shown below.

BROKEN HILL SLIME: LABORATORY TESTS.

	Zinc %	Lead %
Assay-value of slime	32·4	22·3
After roasting	32·0	22·1
,, ,, lead as sulphate		16·2
Assay of zinc concentrate	50·4	6·9
,, ,, lead residue	8·3	42·7
Recovery in zinc concentrate	77·6	
,, ,, lead residue		83·0

RECOVERY IN TESTING PLANT.

Feed one ton per hour.

	Zinc %	Lead %
Zinc concentrate containing	50·4	7·3
Lead residue containing	12·0	41·0

TASMANIA COMPLEX SULPHIDE: LABORATORY TEST.

Ore an intimate fine-grained mixture of blende, galena, and pyrite.

	Zinc %	Lead %
Assay of Ore	30·9	9·9
After roasting, which caused a loss of weight of 7%	33·3	10·5
After roasting, lead as sulphate		6·9
Zinc concentrate	60·0	4·1
Lead residue	3·7	18·9
Recovery in zinc concentrate	81·1	
,, ,, lead residue		81·0

TESTING PLANT RESULTS.

Same ore treated at rate of one ton per hour.

	Zinc %	Lead %
Zinc concentrate	57·0	5·0
Lead residue	5·8	20·0

The application of this process is by no means confined to the Broken Hill slime problem, for as will be seen from the results given above relating to the Tasmanian ores there is every reason to believe that these ores will be amenable to the treatment. Both English and Australian companies have had unfortunate experiences with the complex sulphides at Rosebery, but hopes may now be held out for more profitable handling. By the way, the Gillies and the bisulphite processes are to be tried on these ores as well, but of these I may write on another occasion.

THE ATBASAR COPPER DISTRICT

By W. PELLEW-HARVEY

DURING the last few years English capital has been largely invested in Russian copper mines. The principal companies operating there are the Caucasus, Kyshtim, Spassky, and Atbasar. The last, known as the Atbasar Copper Fields Ltd., is a new concern, the option on the property having been exercised by the present owners as recently as 1908.

Map of Southwestern Siberia. Scale about 250 miles to the inch.

The Atbasar district is situated at Dzhez-Kazkan in the Siberian steppes, 900 versts, or 594 miles south of Petropawlowsk, which is a station on the Trans-Siberian railway and 5½ days' journey from London. Two alternate routes are available, one being from Perowsk, the other Kazalinsk; the adoption of either would considerably reduce the distance from rail-head, but would necessitate the establishment of rest-houses. The existing route by way of Petropawlowsk passes through the important distributing centre of Atbasar; thence over an undulating prairie to the Ulitavs, a low mountain range with easy passes. The descent from this point is gradual towards

Dzhez-Kazkan, which lies about 59 miles south.

The belt of land between Petropawlowsk and Atbasar is being rapidly settled by peasant farmers, who have received Government aid, the result of which is likely to be important in the near future because the ground is remarkably fertile.

A striking feature of the Siberian steppes is the ease with which the ground can be traversed on foot or in carriages, and this particular district is no exception. It is not an unusual thing for an experienced traveller to cover from 130 to 160 miles per day when on the roads along which the mail is transported. At the post-stations, horses are supplied at a rate of $1\frac{1}{2}$ kopecks† per verst* for each horse hired, three being invariably requisitioned; this sum includes the pay of the driver, who expects a gratuity of 50 kopecks for every stage, these being from 18 to 25 versts apart. The above refers to Government rates; horses privately engaged will cost about 1 kopeck more per verst.

The usual custom is to sleep in the carriage, and to provide provisions for the journey, but butter, milk and eggs can usually be purchased on the road. Blankets and pillows should always be taken. In the Siberian steppes there is a complete organization for the transport of goods over great distances at low prices; provisions are generally cheap in Russia and especially in Siberia, as a few examples will indicate. Rice can be bought for Rs. 2·60 per pood ‡; flour, Rs. 1·70; butter, Rs. 10; meat, Rs. 1·70; pork, Rs. 8; sugar, Rs. 8·40; tea (brick), Rs. 1·40; oats, Rs. 1·50, all per pood.

The Atbasar district is about 2000 ft. above sea-level, hence the climate is dry and healthy. The winter lasts from November to February, and the ground is, as a rule, clear for surface operations in early March. The mines are situated on a plateau standing about 70 ft. above the level of the plain. Three rivers flow within 15 and 20 versts, their source being in the Ulitav range. The valleys of these rivers are capable of cultivation and from them is derived, in part, the fodder for the camp. In the immediate vicinity of the mines the ground is arid and unproductive, but it may be possible to utilize the rivers for irrigation; this question should receive early attention.

The copper occurs as an impregnation in sandstone, of arkose character, extending over a wide area in the Kirghese steppes. Specimens of the rock were examined microscopically and the report thereon contains the following statement: "They are grey, fine grained, and silicious rocks composed specially of angular fragments of quartz and felspar presumably derived from granitic rocks. The presence of a certain amount of volcanic material prevents the expression of an opinion as to the source of origin. No evidence of metamorphism has been established, but the felspar has undergone much modification. It has been decomposed and replaced to a great extent by a micro-crystalline aggregate. Here and there plagioclastic felspar is sufficiently fresh to be recognizable; calcite occurs in some specimens, derived in part from the decomposition of the felspars."

The ore is oxidized to a depth of 40 ft.; the sulphides appear below this. The following analyses will be a guide to the composition of the high-grade ore:

	Oxidized. %	Sulphide. %
Copper	15·10	22·00
Silica	57·75	49·10
Alumina	9·42	11·12
Iron	1·89	3·68
Lime	·40	—
Magnesia	1·23	1·91
Sulphur	1·58	8·86
Carbonic acid, Oxygen, combined water, traces of Arsenic, Gold, and Silver, etc.	12·63	3·33

The ground has been tested by diamond-drilling to depths varying from 15 to 450 ft, on the claims known as Petropawlowsky, Pokrofsky, Annenskie, and Krestovozdvijenskie, supplemented by shafts and drifts in the ore-beds. This work has already indicated the existence of ore over an aggregate length of 8780 ft. and a width exceeding 988 ft. So far it has been demonstrated that the main beds have an average thickness of about 3 ft., containing over 14% copper. In one case an aggregate of 33 ft. of copper ore was cut in the various beds intersected, the assays ranging from 1% to 18·5%, of which four layers comprising 10 ft. yielded an average of 14% copper. It must not be inferred, however, that the ore can be worked precisely in this manner. Usually the beds form a synclinal basin, but in certain instances they tilt vertically. On the Petropawlowsky claim, there is a large outcrop, which has been opened for 275 ft. in length at a depth of 40 ft. below the surface, and cross-cuts have been run for nearly 200 ft., all faces being in ore. The

* A verst is 2/3 mile.
† A rouble is 2s. 1½d. and contains 100 kopecks.
‡ A pood is 36 pounds avoirdupois.

copper occurs here as the mineral atacamite. The bed varies between 1·2 ft. and 9·11 ft. in thickness, the average assays yielding 17·9% copper along the drift and 16·51% in the cross-cuts. Where development has taken place at depth, as on the Pokrofsky and Kresto claims, the principal beds show a width of between

General View of the Mines.

$2\frac{1}{2}$ ft. and 3 ft., and an ore averaging 14·83% copper, with from 5 to 11 oz. silver per ton. A specific gravity test of a typical sulphide ore containing 20% copper gave 3·7, corresponding to 234·21 lb. per cubic foot.

Reference has been made to the most important beds as yet discovered. There are

On a tour of inspection.

others lying at different horizons that it is expected will contain sufficient copper to justify inclusion in the known ore-measures. The potentialities of the deposits will be fully appreciated from the simple statement that each 100 ft. square in a bed 3 ft. thick containing 14·83% copper will yield 3000 tons, and correspond to over 444 tons of metal with a gross marketable value in Russia, when best selected copper stands at £60 in England, at over £35,000. It is probable that over a certain proportion of the area the ore-beds will be found in a condition unsuitable for mining, owing to displacements and irregularities com-

Going to Atbasar.

mon to sedimentary deposits of this character. The Mansfeld copper mine in Germany may be cited as an example of a similar deposit; this property has been worked since 1199 and employs about 13,000 men for a yield of 15,000 tons of metal per annum, making it the

A well near the copper mine.

seventh largest copper-producer in the world.

Miners are obtained from the villages of the surrounding region; they are usually inexperienced: the wages are about one rouble per day of 8 hours. Kirghese supply the labour requirements and work for a wage of half a rouble per day of 10 hours. When mining operations are conducted on a larger scale, the local labour supply can be supplemented from around Perowsk, where some 140,000 Kirghese and Sards inhabit the plains. The Kirghese are nomads and form a fine material for workmen. They are a peaceful people, intelligent, careful, and painstaking; with them, no race question is involved.

Timber is one of the most expensive items in mining. The supply for Atbasar is drawn from the forests of Sindiktav, but it is probable that a railway will be built to the district through Kazalinsk from Orenburg, in which case it will be taken from the forests around the latter place. Fuel for domestic and present mining operations consists of a hardwood shrub that grows in great abundance in the district. There is, however, an important coal-field at Bai-Kanour, 80 miles west of the copper district, the coal being of a lignitic-bituminous nature, high in ash, incapable of coking, but quite suitable for reverberatory smelting. This field is an extensive one, and the seams are overlaid to a depth of from 50 to 60 ft. by clay and fossiliferous shale.

The local mining regulations are not at all onerous. A certain production of ore has to be made per annum from each claim, the maximum being 320 tons on option claims and 80 tons per annum on surveyed claims; unsurveyed claims being granted for 5 years without any requirement with regard to production.

The question of ore treatment should not present any serious difficulty; the excess of silica will necessitate the addition of a large proportion of iron and lime for fluxing. These fluxes are available locally. Whether hand-sorting or water-concentration be chosen is a matter that must be left until after further development. Concentration tests on the high-grade ores have been made by oil and other processes. In the case of the former the consumption of oil amounted to 1%, with 1·5% of acid, per ton of ore treated, the ratio of reduction being 2·3 : 1; and the copper recovery, 84·4%. The heavy consumption of sulphuric acid and pig iron will probably militate against lixiviation. I am of the opinion that the ores of the district will eventually be smelted to matte in a reverberatory furnace, and bessemerized.

Russian producers are protected by a tariff of 5 roubles per pood, or approximately £33 per ton. The average quantity of 'lake' and 'electrolytic' brands imported annually is about 62,000 tons. Copper produced in Russia, if unrefined, cannot replace this, as metal of a particular quality is wanted for the manufacture of cartridges and goods of an electro-technical nature. The consumption of crude copper, that is, copper of about 99·5%, ranges between 43,000 and 55,000 tons, the annual production being about 49,000 tons. These figures show that the consumption and production nearly balance; it will be clear therefore, that if the production increases beyond the figure given the copper must either be refined in Russia in order to take the place of the 'lake' metal, or export will be necessary. Without going into details, Rs. 17 per pood rules as the basis price of crude copper, the standard being £88 per ton, with a sliding scale of 15·5 kopecks per pood per £1 up or down, according to the increase or decrease of the standard prices on the basis of 'best selected' as quoted at London. This quotation is for copper at Siberian stations. Roughly, with B.S. at £60 in London, copper f.o.r. Siberian stations will fetch £19 per ton above this or £23. 2s. 6d. at Moscow. The freight on bar copper over the Trans-Siberian railway is based on 50·83 kopecks per pood for a haul of 1320 miles. From Petropawlowsk to New York, the freight is approximately 96·5 kopecks per pood or £6. 7s. 2d. per ton; the corresponding freight to England would be about £5. 15s. 0d. per ton. The distance from rail-head handicaps local industry at the present time, the freight being at the rate of 10 kopecks per pood for each 100 versts. It is inconceivable that with the development of such a large copper district, railway construction will be neglected. With the completion of such transport arrangements, with 'best selected' at about £60 per ton, it is evident, having regard to the character of the deposit and local conditions, that copper can be produced in this district and sold in foreign markets at a price which would show a handsome profit.

Foreign mining engineers have no official status, but can act through the medium of certificated foremen who assume all responsibility to the Government for accidents. A Russian nominee is also required to assume financial responsibilities. These are customary formalities and compliance is easy; it is advisable always to appoint more than one foreman to minimize the risk of the individual importance of such agents assuming too great proportions. The Russian Government is offering every inducement to foreign capitalists, and my own experience is that no difficulties are placed in the way of those who contemplate legitimate mining operations. Siberia affords scope for such enterprise.

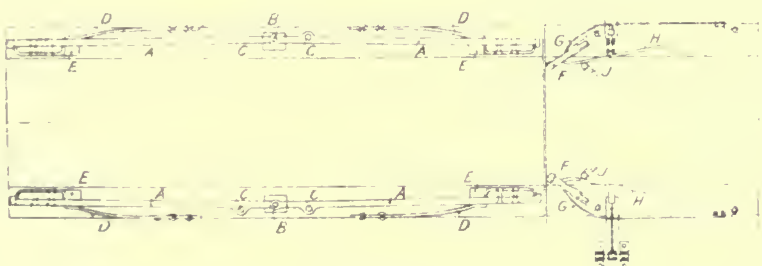
PRÉCIS OF TECHNOLOGY

Preventible Accidents in Mines.—In his presidential address to the South Staffordshire and Warwickshire Institute of Mining Engineers, Hugh Johnstone, H.M. Inspector of Mines, quotes the following figures, which he has compiled from a record of the opinions of the inspectors of that district for a period of two years. They relate to the death or injury of over 600 persons.

Cause	Killed or Injured. %
Defective plant	1·27
Neglect or breach of rule by officials	1·75
Neglect or breach of rule by workmen	9·08
Causes that were preventible by the exercise of greater caution on the part of the persons killed or injured, or their fellow-workmen	35·03
Causes that, broadly speaking, were unpreventible	52·87

In other words, something like 47% of our mining accidents are preventible. He points out that the figures may not be absolutely correct, as it is frequently difficult to obtain precise information as to the cause of an accident but he considers that they are sufficiently accurate for all practical purposes. It is interesting to note that so large a proportion is due, not to wilful neglect or breach of rule, but to want of ordinary care and caution.

Automatic Cage-Tub Stops.—In Vol. 39 of the Transactions of the Institute of Mining Engineers, T. Campbell Futers describes the Winter tub-stop, which is entirely automatic in its action, simple in construction, and is capable of holding the tub securely in the cage. One arrangement of the apparatus is illustrated in plan. The ordinary rail or angle-bars on the cage-deck for the tub-wheels are replaced by channel-bars, laid flat, upon which the treads of the wheels run, similar channel bars being also laid on the heapstead in front of the cage. The snecks are fixed upon these channel-bars, and consist of two pairs of arms A, each being hinged together at B, but separately pivoted to the channel-bars at C, in such a manner that any motion at the end of one arm will give a corresponding motion at the end of the other arm to these arms are fixed the chocks E, which engage with the wheels of the tub when the latter is in position in the cage. The arms, A, are constantly pressed inwards from the side of the cage by the flat springs D. In order to release the tubs, these snecks are pushed outwards at one end by the levers F, which are normally held in the position shown, by the springs G, a position quite clear of the cage. The levers F are moved by means of the arms H, which are pivoted at one end, and abut against the stop J, at the other end in such a manner that, as the tub approaches the cage, the wheels force outward the arms H, and these in turn force outward the arms F, which, swinging round, engage with the ends of the levers A, and thus push outwards the chocks from the tub-wheels inside the cage, setting them free, and allowing the tub to be pushed out by the ingoing tub. As soon as the ingoing tub is in position inside the cage, the chocks automatically spring back and secure the wheels.



Scale, 3 Feet to 1 Inch

Losses in Copper Slags.—J. Parke Channing contributes some remarks on Lewis T. Wright's paper on metal losses in copper slags read before the American Institute and abstracted in our October issue. Mr. Wright said that the copper in slag that cannot be recovered by further smelting is retained in the form of 'prills' of matte. Mr. Channing quotes the opinion of J. E. McAllister, manager of the British Columbia Copper Co., to the effect that the copper in slag is in two forms, one portion contained in occluded matte, and the other existing as oxide. He considers that the same rule will hold good in the case of the silver. Mr. Channing agrees with this view and develops it at length. In early Arizona days, when carbonate ores were being treated, the slags as a rule carried 2½% of copper and seldom less than 1½%, and the economic point was determined by the extra coke required. Arthur L. Walker, then manager of the Old Dominion, at Globe, reckoned that with coke at $60 it did not pay to reduce the copper content of the slag to less than 2½%. At Tennessee, where the ore was well roasted, Mr. Channing never got slags to contain less than ½% copper, yet when treating the ore pyritically the content was less than 0.3%. The above facts are quoted to show the normal tendency of copper oxide to act like iron oxide, lime, or other base, and go into the slag. Mr. Channing, after these preliminary remarks, proceeds to discuss Mr. Wright's examples. In the first case, presuming a 50% matte and a 0·3% slag, the matte would have this analysis: Cu 50%, Ag 31·4 oz., and Au 13·95 oz.; and the slag: Cu 0·3%, Ag 0·147 oz., and Au 0·026 oz. It may be assumed that none of the lost gold is oxidized but all goes into the slag, and from this basis, by comparison with the constitution of the matte, we may calculate the amount of silver and copper contained in the matte in the slag. The following would be the constitution of the lost matte: Cu, 0·093%, Ag, 0·058 oz., and Au, 0·026 oz.; and it follows by subtraction therefore that the loss of copper and silver as oxide would be Cu, 0·207%, and Ag, 0·089 oz. From this it will be seen that only one-third of the total copper in the slag is in the form of matte and the other two-thirds is probably in the form of oxide. Nearly the same ratio exists for the silver, though the calculation is not so exact because some of the loss of silver is due to volatilization, especially in a furnace with a hot-top such as is usual in copper smelting. Mr. Channing says that neither he nor

Mr. McAllister has had sufficient opportunity thoroughly to test the theory here put forward, but it seems to be one that is worth discussion and consideration.

Costs of Copper Smelting.—W. A. Heywood, in the December *Bulletin* of the Institution of Mining & Metallurgy, contributes some discussion on L. D. Ricketts' paper on reverberatory practice at Cananea, an abstract of which we gave in our last issue. Mr. Heywood points out that the great smelters in America have done much to disseminate information about the design and operation of smelting furnaces, but have hitherto been uncommunicative with regard to costs. Mr. Ricketts gives these costs, and therefore adds greatly to the value of his paper. In Mr. Heywood's experience the cheapest reverberatory smelting was at the Highland Boy in Utah, where the cost was 5s. 10d. per ton, and the cheapest blast-furnace practice was at Tennessee, where the cost was 4s. per ton of ore, with coke costing 16s. to 18s. per ton and including the cost of about 20% of barren quartz used as flux. At the Granby blast-furnace the cost of smelting a self-fluxing ore was 5s. per ton with coke at 24s., and more recently with increased size and automatic feeding the cost has probably been reduced.

Amalgamation.—E. T. McCarthy contributed some remarks on W A. Caldecott's paper on heavy stamps in the December *Bulletin* of the Institution of Mining & Metallurgy. Though the amount of ore crushed by heavy stamps is greater than the light ones and the duty therefore increased, Mr. McCarthy is of opinion that the amalgamation is not so good when the duty increases. With the increased weight there is not a proportionate increase in the area of screen-discharge, and therefore no increase in the area where the discharge impinges directly on the plates. It is in this limited area that the plates are most efficient in catching the gold. Increased amalgamating effect cannot be so efficiently obtained by lengthening the plates; in fact, no amount of additional plates below the impingement area will help amalgamation to any extent. It is now usual to add plates at the discharge of tube-mills, and though the necessity for such plates is due chiefly to the greater coarseness of the mill-product, they serve the purpose of supplying the additional impinging area not obtained in the battery. At the British & Korean Corporation's mill in Korea the amalgamation plates below the tube-mill give excellent results on gold-bearing pyrrhotite, in fact, results so good that the cyanide plant was found to be practically robbed of its work. Mr. McCarthy also refers to the question of double discharge. In earlier days the discussion about double discharge hinged rather on this problem of increasing the impinging zone than on the increased duty of the battery.

Efficiency of Crushing Machines.—In the October issue of the proceedings of the Australasian Institute of Mining Engineers, R. W. Chapman, of Adelaide University, gives a method of calculating the comparative efficiencies of crushing machines. He calculates that the amount of energy absorbed in shearing a quantity Q of cubes with side x to a series of cubes of smaller sides z is proportional to $Q\left(\frac{1}{z}-\frac{1}{x}\right)$. This formula would require the calculation of the actual size of the particles and of the reciprocals of these figures. It happens however that these reciprocals are practically double the number of meshes per inch in the Institution of Mining and Metallurgy's table of standard laboratory screens, so that the formula can be greatly simplified thus: Energy absorbed is proportional to $Q(n-m)$; where m and n are the meshes of the material before and after crushing. To apply this formula in practice it is necessary to have the grading analys of the feed and product, and to multiply the various meshes by the corresponding percentages of material passing through each. Theoretically the analysis should be close, but this would involve too much work. For practical purposes it is sufficient to average at 30-mesh the material passing through 20-mesh but not through 40, and so on, and to add say 20 to the finest mesh. As an example, suppose two machines, A and B, give the following results:

MACHINE A.

Grading	Feed %	Product %
From 20 to 40	10·3	—
„ 40 „ 60	18·7	—
„ 60 „ 80	23·5	—
„ 80 „ 100	12·2	4·3
„ 100 „ 120	18·6	19·7
„ 120 „ 140	10·4	28·6
„ 140 „ 160	4·8	21·7
Through 160	1·5	25·7

We multiply the mean of each grading into the percentages, add up the results from the feed and product, and subtract the latter from the former, thus:

Average Mesh	Result of multiplying percentage of each by average mesh — Feed	Product
30	309	
50	935	
70	1645	
90	1098	387
110	2046	2167
130	1352	3718
150	720	3255
180	240	4626
	8345	14153

The difference 14153—8345 = 5808 is to be multiplied by the quantity of ore treated during a certain time, say, one day. If Machine A treated 20 tons the work done would be proportional to 116,161.

Now take another machine, B, which crushes 17 tons per day, with the following grading analysis:

MACHINE B.

Grading	Feed %	Product %
From 20 to 40	0 5	—
„ 40 „ 60	5·8	—
„ 60 „ 80	29·6	—
„ 80 „ 100	31·3	—
„ 100 „ 120	14·7	6·2
„ 120 „ 140	8·2	12·5
„ 140 „ 160	7·9	47·2
Through 160	2·0	34·1

Working out the result as before we get:

Average Mesh	Result of multiplying percentage of each by average mesh — Feed	Product
30	15	
50	290	
70	2072	
90	2817	
110	1617	682
130	1066	1625
150	1185	7080
180	360	6138
	9422	15525

The difference between 15525 and 9422 = 6103. This multiplied by 17 gives the 103,751. The crushing efficiencies of the two machines, A and B, are therefore in the proportion of 116,160 to 103,751. The theory of this method is similar to that of Von Reytt, as quoted in Richards' 'Ore Dressing.'

Shaft-Sinking through Wet Ground.—At the December meeting of the North of England Institute of Mining and Mechanical Engineers, John Cummings read a paper describing the sinking of a shaft through wet ground at the Hamsterley colliery near Newcastle-on-Tyne by means of underhanging tubbing. This is the first instance of the method being used in England, though it has been employed in Germany. This shaft was sunk with the object of draining the lower levels of the coal measures. At the site chosen a bore-hole showed the existence of wet sand and gravel from a few feet below the surface to a depth of 25 ft., with layers of loose clay, shale, boulders, and soft sandstone down to a depth of 54 ft., at which point a strong sandstone was cut. As the surface ground was firm and hard it was decided to adopt the present method. The inside diameter of the shaft was to be 10 ft. Operations were commenced by excavating an annular trench to a depth of 4 ft. with an outside diameter of 19 ft. An annular foundation-ring was made in this trench with reinforced concrete; its dimensions were 10 ft. 10 in. internal diameter, outside diameter 19 ft., and depth 3 ft., and its top was 1 ft. below the level of the ground. Upon this was placed the hanging-ring or curb (see illustrations). This was made of cast-iron in six segments bolted together. The depth was 11 in., and the width of the ring lying on the concrete bed was 19¾ in. The clear inside diameter was 10 ft. In laying the concrete bed and the hanging-ring great care had to be exercised in order that the suspending surface should be perfectly level, as on this depended the vertical direction of the shaft. Excavation commenced by digging a pit to a depth of five feet. This presented no difficulty, as the sides were already protected by the 3 ft. of the concrete ring. The first course of tubbing was then put in and bolted to the bottom flange of the hanging ring. All the joints were machined so as to fit exactly, and strips of lead sheeting were inserted between them. Lead washers were also used on the bolts. When the tubbing was in place the space below was well rammed with puddled clay. Liquid cement was then poured through the grouting-holes in the hanging-ring, so as to form a solid backing for the tubbing. While this was being done the grouting-holes in the bottom of the tubbing were plugged, partly to prevent the grout from running through them, and partly to keep the holes open for use when the succeeding ring of tubbing was attached below. As the whole of the tubbing to be placed in the shaft would have to be held up by the concrete ring and the hanging-ring, additional strength was given to the rings by placing two 12 in. square timbers across them, extending to the ground on either side. These were attached by bolts to the hanging-ring and in this way the weight of the tubbing was distributed. It will be seen that the outside of the segments was made with ridges, to enable the cement grout to bite and also to hold the tubbing in place. Two different sizes of tubbing were provided: some were 5 ft. deep, the circle being made in six segments; and the others 2 ft. 6 in. deep, in eight segments. The former were used where the ground was comparatively firm and the latter where it was wet. The segments were successively fixed in position and bolted tight one by one; in order to introduce the last segment the side of the pit had to be further excavated. After the first course of tubbing had been introduced water began to appear at the bottom of the pit. Excavation for the succeeding ring of tubbing had to be done cautiously by digging out sufficient ground for one segment at a time and holding the wet sand back by short wooden piles. A great quantity of brushwood was used for the same purpose at this and succeeding levels. The ground became more difficult with depth, and at the fifth course the men had to stand on planks to avoid sinking. Until the shaft had reached a depth of 12 ft. the amount of water was not greater than could be lifted by a hand-pump. At this depth a small electric centrifugal pump was used, capable of extracting 150 gal. per min. A sump was made in the centre of

Fig. 1.—Section of Shaft.

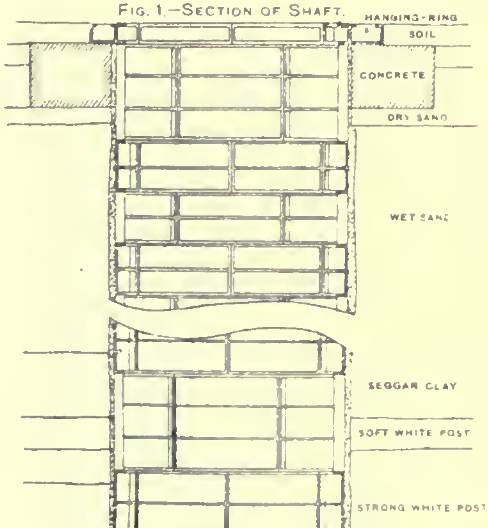


Fig. 2.—Section of Hanging-ring and Tubbing

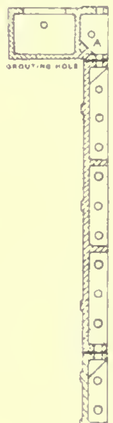
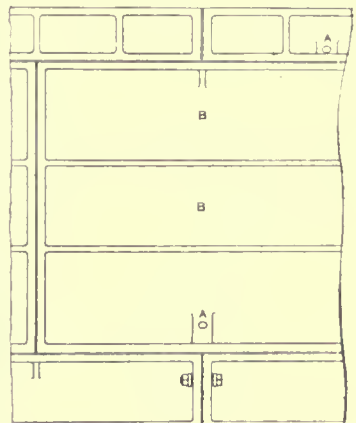


Fig. 3.—Development of Hanging-ring and Tubbing



the pit by means of a wooden frame 3 ft. square and 18 in. deep. When the shaft had been sunk 30 ft. and the ground had changed from sand to boulder clay, hardly any water came in. After the soft ground had been passed at a depth of 55 ft. the shaft was continued 30 ft. into the rock. This was lined in the usual way with stone 9 in. thick commencing from the bottom. At a distance 6 ft. from the lowest ring of tubbing an elm frame was inserted round the top of the wall and a final course of tubbing inserted in tight contact with it. The whole time occupied in completing this work was 28 days, and the cost was £768, of which £627 was for materials and £141 for labour, or just under £14 per foot for the 55 ft. of tubbing. The total weight of the tubbing was 56 tons. As regards the general applicability of this system, it would appear to be difficult to work if the pressure of the incoming water is great, for it would not then be easy to introduce the grout or to puddle the bottom of each course tightly. Nor would it be applicable in case the surface of the ground was not strong enough to support the weight of tubbing.

Cyanide Plant in Rhodesia.—F. J. Thomas read a paper on the small cyanide plant used in Rhodesia, at the September meeting of the Chemical Metallurgical and Mining Society of South Africa. When the cyanide process was first applied to Rhodesian mines the design of plant on the Rand was generally adopted, and such expensive things as double-tier steel vats on masonry foundations and lofty buildings with cement floors were quite the rule. These mines were mostly operated by wealthy companies able to afford this initial outlay, though the mines should in most cases not have been saddled with such extravagant initial costs. Since 1900, the 'small man' and the private syndicate have come to the front, and it has been necessary for the machinery houses to offer something less pretentious but equally efficient for the purpose required. There are at the present time about 80 small cyanide-plants working. Mr. Thomas in his paper gives details of the vats and tanks, the pumps, the method of handling the material, cleaning up, furnace work, etc. Instead of steel vats, or even square wooden tanks, corrugated iron vats are now universally used for almost every purpose. These are cheap, portable, and easily erected, and if they are properly built are not likely to leak. It is necessary to point out that the proportion between the thickness of the material and the diameter of the vat must be such as to make the structure strong enough. For instance, it is hopeless to expect a vat made of 24 B.W.G., that is, of a sheet 0.022 in. thick, to be strong enough unless it is not over 4 ft. deep. A tank 14 ft. diameter and 6 ft high made of this thickness of material will commence to buckle directly it is filled. But if sheets of 22 B.W G., or 0.028 in., are used, such a vat will be quite strong enough. There are several other points to be remembered in the construction of such tanks. For instance, all joints should be double-riveted, and soldered both inside and outside. The top rims should be strengthened by a band of angle-iron or gas-piping In caulking down the overlapping portion of the filter-mat it should not be hammered into position in a ruthless manner, as this is likely to break the solder along the joints. Ample space should be allowed between the grating and the side of the tank. The foundations for the vats may be made by levelling the ground, thoroughly soaking it and beating it down, and placing on top a layer of sand 2 in. thick. This sand will provide a foundation that will accommodate itself to any slight irregularities and the vats will remain securely in position upon it. For extractor-boxes, the circular vat is not so much in favour; the independent compartment design is more popular, and sometimes the full length partitioned box is found. Out of the 80 mines working small plants only three treat slime. In a few cases the slime is allowed to bake in the sun and it is then broken up and mixed with the sand. At many of the mines the slime is allowed to run away, but in most cases it is stored for future consideration.

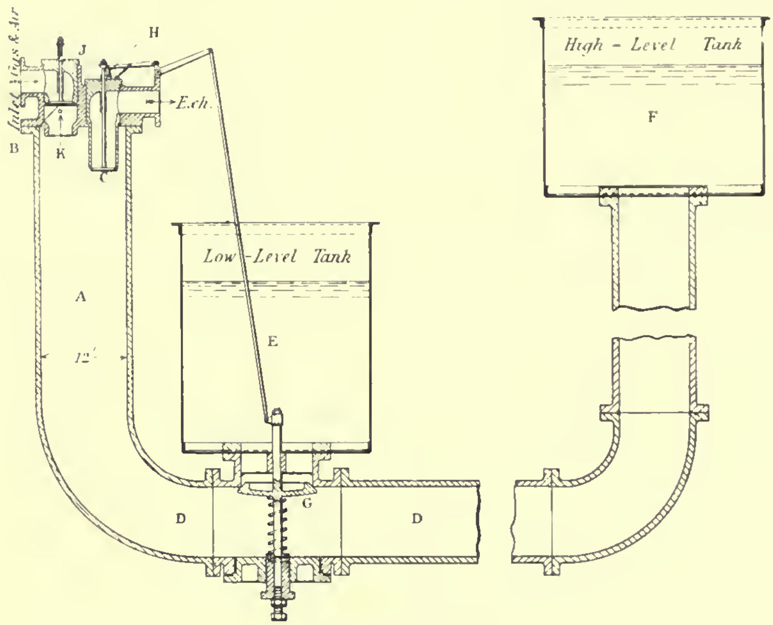
Extractor-Box.—The *South African Mining Journal* for November 13 contains a description of a new rotating extractor-box designed by Messrs. Lloyd and Rand, the cyanide manager and foreman at the Cason mine, of the East Rand Proprietary. The inventors call it the 'Rotor.' It consists of compartments containing the zinc clippings and rotates slowly, the usual speed being 1½ times per minute. The container is supported on a hollow shaft through which the solution enters. Radial holes in the shaft allow the solution to pass into the container and come in contact with the zinc. As a rule three of these machines are employed, and the solution passes successively through them. The rotary motion tends to rub off the precipitated gold, which falls to the bottom and passes into a tank below. A clean-up is made every day, when a valve at the bottom of the gold-tank is unlocked and the current connected to the filter-press, the effluent solution being returned to the 'rotor.' Clippings about an inch square from ordinary sheet zinc are used. Owing to so much of the gold being rubbed off, the treatment of the zinc is unusual. It is not necessary to dissolve all the zinc, but only sufficient to liberate the gold adhering. Thus the consumption of both zinc and sulphuric acid is substantially decreased. After being treated in the acid bath, the zinc clippings are returned to the machine and are found not to contain more than 0.3% gold. The clippings are treated with lead acetate in the usual way. It will be seen that in this machine the gold precipitate is always under lock and key, and that it is as easy to clean-up every day as two or three times a month.

Tin Mining in China.—Information about the tin production of China and the methods of mining and smelting is scanty, and the amount of tin used in the country, chiefly for the manufacture of bronze, can be only vaguely surmised. The paper presented by W. F. Collins at the December meeting of the Institution of Mining and Metallurgy provides interesting details. Nearly all the tin produced in China comes from the alluvial mines at Kotieou, or Kotchiou, about 30 miles to the west of Mengtze or Mungtze, in the province of Yunnan. The output varies greatly owing chiefly to rebellions, attacks of plague, and low prices, but on the whole there has been a substantial increase of production during the last eighteen years, the estimated figures having risen from 1750 tons in 1891 to 4500 tons in 1908. At one time, in earlier days, it is probable that the output was as high as 6000 tons. Most of this tin is reported to go to Hongkong, where it is refined and exported, though a substantial portion must be used for domestic consumption. Actual figures are difficult to obtain, though the authorities of the Imperial Maritime Customs now keep a fairly accurate track of both the production and export. The industry is entirely in the hands of the Chinese, and the methods are primitive. Concentration is conducted with difficulty owing to the shortness of water supply. Charcoal is expensive and transport is difficult. It is probable that on the completion of the Haiphong-Yunnanfu railway, which will provide communication from Mengtze to the gulf of Tongking, the cost of production may be decreased and the industry stimulated.

There are altogether 150 separate workings scattered over an area measuring 25 by 20 miles. The deposits are all alluvial and are found in depressions in limestone of Triassic age. The cassiterite occurs chiefly in the size of sand and is associated with magnetite and hematite, together with small quantities of galena. Most of the mining is done by open-cast, but where the deposits are deep and the content of the lower parts high, a system that may be most easily described as underground burrowing has been adopted. These burrows are generally at an angle of about 45° and no ladders are used. The burrows are seldom 5 by 3 ft., and are usually only just large enough for the miners to crawl through. Some of the burrows are as much as 1000 yards long. There is no attempt at ventilation and even at the mouth of the burrows the air is indescribably foul. Inside the air is so bad that lights burn with difficulty, and it is a wonder that the miners can work at all. There is no water in the gravel, so the ground keeps in place and accidents are few. The method of concentration is shown in the accompanying illustrations. After the gravel has been loosened by beating with a flail it is separated into coarse and fine. The coarse is fed gradually on to brick-faced buddles, and sprays of water are directed upon it while it is stirred with rakes. Water lies in reservoirs at the bottom of the buddles, and its level can gradually be raised as the concentrate accumulates. When sufficient has been collected, it is put into bags and sent to Kotieou, where it is crushed and re-concentrated. The finer ore is concentrated on buddles provided with boarded faces. These two types of buddle are fully shown in the drawings. The smelting is all done at Kotieou, where there are altogether 29 furnaces. The bricks are made on the spot and blast is supplied by a wooden air-pump having a piston packed with feathers. The output of each furnace is from 15 to 20 blocks weighing 146·6 lb. per day. Ten men are required to look after each furnace and they work five to a shift of six hours. Three men operate the blower, one sees that the metal runs properly from the tap-hole, and another is engaged in feeding the ore and charcoal. The slag is crushed and washed so as to extract the 'metallics' and is then sent back to the furnace until as much tin is recovered as possible. The author estimates that the cost of building a furnace and house is £200.

Tchou or Chinese tin concentrating method at Kotchiou, in Yunnan.

Internal Combustion Pump. At the November meeting of the Institution of Mechanical Engineers, Herbert A. Humphrey read a paper describing a pump actuated on an entirely new system. The water is forced up the pipe by means of the explosion of a mixture of gas and air that acts directly on the water without using any piston. This new system has given surprising results from the point of view of economy in coal consumption and in cost of construction and maintenance. The paper was not written with any special reference to its application in mining, but it seems to have an important bearing on the future of mine drainage. The accompanying illustration shows diagrammatically the principle on which the new pump works. Water is to be raised from the tank E to the tank F. The pipe A is a combustion chamber for the explosive mixture which is introduced through the valve B. The outlet for the waste gases is through the valve C. The ignition is effected by the sparking plug K. Suppose the water is high in A and that the space above is filled by a compressed charge of gas and air. The inlet and exhaust valves are shut, as also is the valve *G*. On explosion the water is forced down the pipe *A* along the pipe *D* and upward into the high-level tank *F*. As the gases expand, their pressure diminishes, though the body of water still continues to flow upward. When their pressure falls below a certain point the valve *G* opens and water flows from the low level tank *E* into the pipe *D*. At the same time the system of levers connecting *G* with the exhaust valve *C* comes into operation and the valve *C* is opened. The water entering through *G* partly flows onward with the current, and partly into the chamber *A*, expelling the exhaust gases. When the flow to the higher tank ceases and the column of water



Internal Combustion Pump.

tends to fall, the valves *G* and *C* are closed. The imprisoned gas acts as an elastic cushion and after being compressed expands again causing the water to flow along *D* toward *F* again. A suction is therefore created on the inlet-valve *H* and a new charge is drawn in above the water-level in *A*. The water once more flows back and compresses this charge, and the ignition from the sparking-plug sets going the cycle of operations once more. The height of lift in this apparatus is naturally limited to from 35 to 40 ft., but by means of additional air chambers the height may be increased. The above is, of course, a mere outline of the principle of the pump, and many points of interest are omitted in this short abstract. The author describes in detail a number of practical machines built on this principle. Some of them employ a two-stroke cycle instead of the four-stroke cycle described here. He also shows how the system may be applied to the compression of air. The paper should be read closely as well as the discussion which it evoked. The mining engineer will immediately see that the system is particularly applicable where the Cornish pumps, tanks, and pipes are already in place. The heavy engine at the surface and the pit-rods would be rendered unnecessary. This apparatus is simple. There is no piston to keep in order, and the walls and valves of the explosion chamber are kept cool and clean by the water. In tests conducted by W. C. Unwin the amount of coal used was only 1·06 lb. per pump horse-power hour.

Leaching Copper Ore in the Ural.—At the December meeting of the Institution of Mining and Metallurgy, Alfred L. Simon added to the literature relating to Russia by presenting a paper on the copper-leaching plant at the Gumeshevsky mine 30 miles south of Ekaterinburg. The plant was put into operation in 1907 with the object of treating the old dumps of oxidized ore. The mine forms part of the Sissert concession, which was originally granted for the development of iron mines. Later on, in 1727, copper deposits were discovered, and two mines, the Polefskoi and the Gumeshevsky, were opened. Both of these mines worked oxidized ore exclusively. The former was closed so long ago that no records have been preserved, but the latter was in operation as recently as 1871. The records show that the oxidized copper ore was found in large irregular masses along with similar bodies of limonite in a clay formation occurring at the contact of limestone and diorite. A few years ago the old dumps attracted attention. They cover 20 acres and have an average depth of 17 ft. By means of trial-pits the copper content was found to average 23 lb. per cu. yd. The amount of ore contained in the various dumps was estimated at 680,000 cu. yd. and the copper content at 7000 tons.

Laboratory experiments proved the possibility of extracting a fair proportion of the copper, but before erecting a large plant, a small testing-plant was provided for the purpose of obtaining conclusive information. This testing-plant was sufficiently large to deal with 19 cu. yd. at a time. It consisted of a Chilean mill, a vat provided with a stirrer, and precipitation-boxes. The acid was added in the vat and the copper was deposited from the sulphate on iron. The process of agitation, decantation, and precipitation was conducted three or four times for each charge. It was found that the extraction was 56½% of the copper content, the actual figures at the tests being 12·78 lb. extracted and 9·94 lb. left in the residue. The extraction was low because much of the copper occurs as silicate. The consumption of sulphuric acid was high on account of the large amount of alumina and iron in the gangue. One cubic yard consumed 127·8 lb. of acid at 53° B. The amount of iron required to precipitate one pound of copper was 3½ lb. Five days were required for the treatment of each charge. A close calculation of the cost of operation and estimated expenditure on a plant capable of treating 68,000 cu. yd. per season of 150 days showed that such a plant would cost £21,000 and that copper could be produced at a cost of £45 per ton. At first it was intended to buy sulphuric acid in the open market, but while investigations were proceeding an extensive deposit of cupriferous pyrite was found about four miles away, and a firm of sulphuric acid makers undertook to erect a local factory on condition that they should receive the contract for supplying the acid. As the pyrite contained 3½ to 8% of copper the recovery of the metal is an important part of the acid manufacture. The erection of a plant to treat 68,000 tons was commenced in 1907 and was nearly completed in the autumn of that year. During 1908 the remaining vats were finished, and the plant ran for two months, when operations had to be suspended for the winter. At first the expense of operation was much higher than the estimate, but during the past summer, as the plant got into better working order, the cost was reduced, though it is still higher than was expected. During the first fortnight of June 1909 the amount of dump material treated was 7735 tons and the copper precipitated was 33 tons. At the same time the consumption of acid at 53° B. was 341 tons and of iron 62·45 tons. The operating cost was £1287 or 3s. 4d. per ton of dump ore or £39 per ton of copper produced. To this cost of copper £14 per ton must be added for general expenses and redemption of capital, so that the cost of production is £53. This increase over the estimate is due partly to the extra allowance of £4 for redemption of capital, the plant having cost more than was expected, and partly to the greater cost of sulphuric acid, which is 17s. 9d. per ton instead of 9s. 8d. as estimated. The cost of erection of the leaching-plant was £26,500.

In operating the plant the dump material is first reduced in a Blake crusher, gravel-pan, Chilean mills, and ball-mill, with intermediate picking-tables. The final product is sufficiently fine for half to pass through 136 mesh. The leaching-plant consists of ten rectangular vats, 183 ft. 9 in. long, 42 ft. wide, and 6 ft. 6 in. deep, with sloping sides, each containing 154,000 gallons. They are built on bedrock and the walls are of stone set with lime mortar. The bottoms and walls are covered with a layer of concrete 4 in. thick on which is laid a layer of asphalt 1 in. thick. An electrically-driven travelling crane carries three agitators, which are also operated by electricity; these are moved about from one vat to another in order to stir the pulp periodically. In charging the vats, pulp of a consistency of 1 part solid to 2 parts water, containing altogether 300 tons of dump ore and 13·2 tons of sulphuric acid at 53° B. is gradually introduced, an operation occupying 8 hours. The pulp is then agitated for 9 hours and sufficient water added to fill the vat to the brim. After settlement, the solution is drawn off and sent to the precipitation-vats. The leaching-vat is then re-filled with water and the contents agitated a second time for four hours. This operation is repeated twice more and the tailing is then discharged by means of a sand-pump. Each decantation from a leaching-vat contains 152,000 gallons. The first decantation contains 84½ gr. copper per gallon and the second, third, and fourth 37½ gr., 22½ gr., and 10½ gr. respectively. There are 20 precipitation-vats, each 43 ft. by 18 ft. 8 in. by 2 ft. 7 in., made with concrete and lined with asphalt. They are arranged in five rows, four tanks in each row. The upper vat in each row is filled with 110 to 120 tons of pig-iron plates, and the other vats are provided with false inclined bottoms covered with a layer of granulated iron 4 in. thick. The vats filled with plates are cleaned-up every three weeks and the others at intervals varying from 4 to 8 days. The copper is removed from the plates by scraping, and from the granulated iron by revolving it in perforated cylinders, the friction of the granules being sufficient to rub away the deposit. About 95% of the copper is recovered from the solution. The idea of treating these dumps is due to August Hoffman, who also designed and erected the plant, and is now superintending operations. Dr. Simon's paper is made additionally interesting by means of working drawings.

Leaching Copper Ores.

System of Agitation.

Mansfeld Copper Mines.—In point of interest Mansfeld copper mining has long and justly been conspicuous in the annals of the industry; less, perhaps, on account of its magnitude than because of its peculiar technical conditions and the superior quality of the metal produced. This is emphasized by Leon Demaret, Chief Engineer of the Corps des Mines, in a pamphlet recently published at Brussels.

The copper-bearing bituminous schist exploited at Mansfeld is of Permian age and is known as the Zechstein schist. This formation is sandwiched between red and variegated sandstone beds. The formation is dislocated by numerous faults, the planes of which dip in the same direction as that of the orebody itself. These faults displace the ore in varying degrees, the maximum throw being 81 metres. The lode-filling consists of niccolite (NiAs) and iron pyrite.

The Mansfeld deposit has been mined for 700 years, with intervals of comparative idleness up to 1852, but since then without intermission. In 1852 the present company was formed, the *Mansfeldsche Kupferschieferbauende Gewerkschaft*. In 1907 the output of copper was 19,140 tons. The profits divided in the same year amounted to 4,838,400 marks, or £241,930, on a total capital of 86,392,000 marks, that is, 7·14 marks per ton of ore treated and 252·78 marks per ton of copper produced.

Ore is extracted from nine groups of workings, each having one or more shafts. Exploitation at present is confined to the Eisleben-Hettstedt group, these workings having a development of 25 kilometres on the strike. Five new shafts are being sunk to depths of from 500 to 700 metres. These are provided with electrical winding-engines. The method of mining resembles that ordinarily adopted for coal. It is done by means of vertical shafts with drifts at intervals of 63 metres, the ground thus opened being then cut into blocks 100 metres long. Owing to the narrowness of the ore deposit, 20 to 30 cm. (8 to 12 in.), the stoping is inevitably expensive. Both at the face and when transporting the ore the workman has to work lying down.

The mines are not dry. Pumping arrangements have to provide to deal with 200 cubic metres per minute. Large cavities exist, causing sudden irruptions, which occasionally inundate the workings. By numerous underground pumps the water is raised to a drainage adit having a length of 32 kilometres.

The output in 1907 was 676,415 tons. The average tenour was 3·3% copper and 0·016% silver. The cost per ton was: stoping and transport 14·80 marks, development 3·23 marks, preparatory 1·21 marks, construction and maintenance 1·57 marks, drainage 1·26 marks, winding 7·60 marks, construction at the surface 1·19 marks, expenses at the surface 5·52 marks, total 36·38. The ore, being argillaceous limestone impregnated with friable sulphides, is not suited to concentration by water. After being enriched by hand-sorting, it is subjected to roasting in the open air, chiefly in order to drive off the bitumen. This operation requires four weeks. Thus prepared the schist ore is mixed with raw cupreous limestone *(dachberge)* and goes to the furnace without further admixture. It is therefore self-fluxing. The sorting is supposed to reject all schist ore of less than 1·7% copper and all *dachberge* less than 1·3% in copper.

The operations are summarized as follows:

Oxidations	Reductions
I. Roasting in heaps.	
II.	Fusion for matte in blast-furnaces
III. Calcination of matte.	
IV.	Fusion in reverberatory furnace for concentration.
V. Sulphatizing for desilverization.	
VI.	Refining.

In 1907 the ore smelted in 13 blast-furnaces amounted to 678,568 tons or 151 to 168 tons daily for each furnace. The average matte contained 41·22% copper; 0·222% to 0·269% silver, and 23 to 25% sulphur. The slag contained 0·2% copper. Coke was consumed to the extent of 0·2 ton per ton of ore treated. Water for cooling the jackets amounted to 1·5 litres per ton of ore. Air was consumed at the rate of 1000 cubic metres per ton of ore. The pressure of the blast was 8 to 10 c m mercury. The final matte carries 74·24% copper and 0·4198% silver.

The slag, run into moulds and allowed to cool beneath a layer of sand for 48 hours, is valuable for paving and masonry, and realizes a handsome revenue.

To extract the silver, the final matte, after being first broken and afterwards ground in a ball-mill, is sent to a modified Parkes' calciner for sulphatization, and is then subjected to the Ziervogel process. This is followed by the refining of the residue after the silver has been extracted. The residue contains:

	%		%
Copper	73·66	Nickel	0·442
Silver	0·002	Cobalt	0·144
Lead	0·743	Sulphur	0·536

The copper being in a state of dioxide is treated in a reverberatory furnace with an addition of 8% of fine coal. The resulting blister copper undergoes another operation in the same furnace, from which it is cast into ingots. From the reverberatory furnaces the quantity of residue treated in 1907 was 23,309 tons, containing 73·87% copper; the refined copper contained was 17,245 tons, so that each ton of residue gave 0·74 tons of refined copper. To this must be added 1836 tons of copper from the treatment of flue-dust and the electrolytic treatment of fume. The electric copper is 99·999 fine, and contains 0·001% silver; its conductivity is from 58 to 59. The extraction for the year was 80·3% as to copper and 92·4% as to silver; 14% of the copper loss was incurred in the first smelting to matte.

Experiments have been made on the matte with the Bessemer-Manhès process. As, in this case, the sulphur is the principal fuel, only mattes containing at least 30% copper can be treated.

The rich matte is refined electrolytically. The consumption of fuel per ton of copper was 5 tons as compared with 15 tons required by the German process. There was also the advantage of less labour cost and greater facility for recovery of the silver and the nickel. The loss of silver by volatilization is small so long as the matte does not exceed 72% copper. The main reason for abandoning bessemerizing is the difficulty in regulating the consumption of sulphurous acid fume to the capacity of the chambers, and also the largeness of expenditure in plant.

The Barberton Goldfield.—At the October meeting of the Chemical, Metallurgical, and Mining Society of South Africa, A. Richardson read a lengthy paper on the Barberton goldfield in the eastern part of the Transvaal. He gave the history and described the geology of the district; also discussed the methods of development and stoping, and the metallurgical treatment, and analysed the costs.

Assay of Cyanide Solutions.—The application of De Wilde's method of assaying cyanide solutions and slime residue introduced on the Rand by A Whitby has been generally known locally for seven years. Recently W. S. Duprey worked out the same method in Mexico and described it as new in the *Mexican Mining Journal* for July last To put matters right, A. Whitby read a paper at the October meeting of the Chemical, Metallurgical, and Mining Society of South Africa describing the details of the operation of the process.

Stripping by Hydraulicking.—In the *Mining & Scientific Press* for December 11, A. F. Hughes describes the hydraulic method of removing a soft porphyritic overburden adopted at the Trinity gold mine, California. Water is plentiful and there is no regulation to prevent the discharge of the material into the rivers in this part of the State. A giant with 2½ in. nozzle was used, and the ground was loosened by means of auger-holes. In three months 150,000 cu. yd. of overburden was removed at a cost of $2800: a rate corresponding to about 1⅓ cent per ton.

COMPANY REPORTS

Homestake.—The reports of the Homestake Mining Company, which owns the famous low-grade gold mine at Lead, South Dakota, are not illuminating documents. The report for the year ended June 1 shows that 1,505,302 tons of ore were treated, yielding gold to the value of $5,725,046, an extraction of $3·80 per ton. The total expenses were $4,267,182 and the dividend was $1,365,000. The development work during the year consisted of 10,741 ft of drifts, 567 ft. of raises, and 262 ft of shafts. The hydro-electric station at Spearfish creek, 12 miles from the mine, has been commenced, and will require 18 months to complete. The work will approximately absorb one million dollars, but the cost of power will be materially reduced thereby. This is practically all that the report tells us. The control is in the hands of J. B. Haggin, T. J. Grier is superintendent, and C. W. Merrill is consulting metallurgist

Mount Elliott.—This company was formed in London in June 1907 to acquire the property of a Melbourne company of the same name, consisting of the Mount Elliott copper mine at Cloncurry, North Queensland Among the directors are W L Baillieu, W. S Robinson, and William Clark W H Corbould is general manager, having been appointed in February The report for the year ended June 30 shows that the blast-furnace and converters started operations about the middle of May, and from that time to the end of June smelted 3800 tons of ore, producing matte and blister copper equal to 501 tons of blister copper It will be seen that this is an extraction of 13% of copper from the ore The gold content of this copper runs about 1½ oz per ton Mr Corbould estimates that above No. 3 level there are 102,800 tons of ore from 10 to 12% copper Between No 3 and No 4 levels there are 40,000 tons of ore ranging from 6 to 10% and 125,000 tons of lower grade which can be dressed up to from 5 to 10%, without any trouble Development and prospecting work is encouraging laterally, but at the lowest level there is no appearance of a solid body of ore as in the upper levels Mr Corbould does not have a good account to give of the smelting plant Both the blast-furnace and the converters are cramped, and charging facilities and ventilation are imperfect By his recommendation the plant is being re-built elsewhere and should be ready to start work again next May

Mount Zeehan.—This silver-lead mine in Tasmania has for a year or so shown signs of exhaustion, and the present report, covering the year ended June 30, shows an adverse balance for the first time during a life of 20 years The Spray lode, which supplied most of the ore, has come to an end as far as the present workings are concerned, but the engineers are prospecting at other parts of the outcrop in hopes of getting into ore again The Government have sent two of their geologists, Messrs Twelvetrees and Ward, to make a thorough examination of the district in hopes of finding evidence that will aid development The engineers in the meantime are altering the concentrating plant for the purpose of re-treating the tailing heap, which contains over 60,000 tons assaying 4% lead and 10 oz of silver. The company in addition to owning this mine owns 37,000 out of 80,000 shares in the Zeehan Montana This mine has also been in a bad way recently, and it looked as if silver-lead mining would have to be abandoned entirely in this district More recently, however, a new find has been made at the Zeehan Montana, which may prove more encouraging

Messina.—The Messina (Transvaal) Development Co. was formed by Chaplin, Milne, Grenfell & Co. in 1905 to acquire the Messina mine in the northern part of the Transvaal. R. J Frecheville is one of the directors, J. M. Calderwood is consulting engineer, and Allan Woodburn is manager. The mine was worked in prehistoric times and is rich in chalcocite. Owing to its inaccessibility it has not yet been advisable to proceed rapidly with development and production. The cost of transporting supplies precludes for the present any scheme for smelting locally, and the cost of shipping concentrate to Swansea is excessive. The policy has therefore been to go slow, to ship sufficient high-grade concentrate to pay expenses of development, and to wait for railway connections. Last June an extension of the Pretoria-Pietersburg railway to Bandolier Kop was authorized, and its construction is already well advanced. In addition another railway connecting with Delagoa Bay is being built from Komati Poort to Leysdorp. These lines will join somewhere south of Messina and an extension will be built to connect with Bulawayo When completed this will greatly reduce the cost of transport. During the year the development of the mine has been satisfactory. The rich ore has been proved to exist down to 400 ft., where a winze contains ore assaying 20%. The high-grade ore reserves on June 30 have been increased to 43,315 tons having an average content of 15% copper. In addition there are 10,000 tons of lower grade ore, and it is safe to estimate another 60,000 tons of 'probable' ore During the year ended June 30, 1906 ft of development work was done at a cost of £8471, and the high-grade ore reserves were increased by 15,533 tons. During the same period 15,011 tons assaying 12% copper were milled, yielding 2240 tons of concentrate assaying 52 3% copper, together with 1217 tons of middling averaging 20 5% copper, and 56 tons of pyrite concentrate averaging 31·8% copper. The total recovery of copper was 80%, and the average assay-

The open-cut on the Homestake Lode.

value of the tailing and slime was 2½% copper. Of the rich concentrate 1885 tons were sold to Swansea, yielding £53,135, or £28 per ton. The cost of shipping to Swansea averages £5. 17s. 6d. per ton. The cost at the mine, including development, redemption, depreciation, shipping charges, &c., was £45,802, the London office expenses £3805, and interest on debentures, overdrafts, etc., £3650. The total expenses were therefore £53,257, which practically balances the receipts from the sale of concentrate. The company has an overdraft at Chaplin, Milne, Grenfell & Co's. of £42,591, and there are other creditors. It is intended when railway communications are completed to raise further capital in order to straighten finances and actively pursue operations. Though present conditions are disadvantageous, the ultimate prospect is distinctly hopeful.

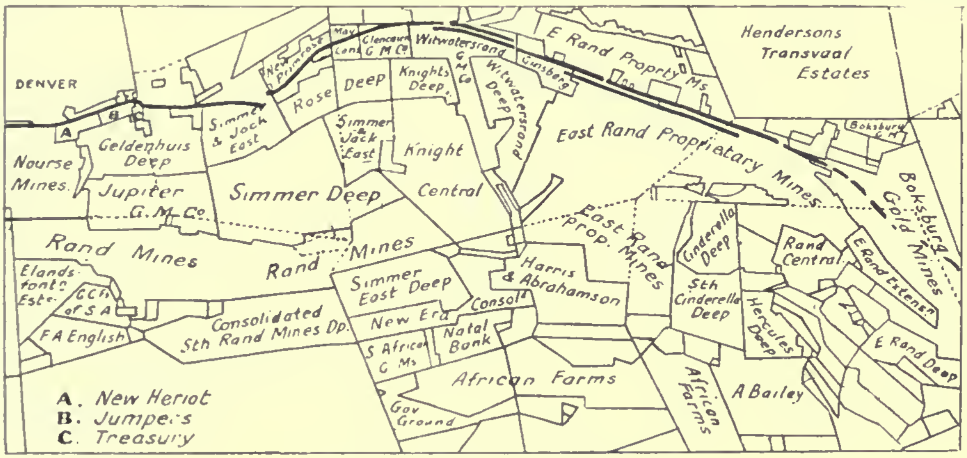
Sulphide Corporation.—This company operates the Central mine at Broken Hill and is controlled by Gibbs Bright & Co., the Melbourne house of Antony Gibbs & Sons. C. F. Courtney is the general manager. When the company was originally formed in 1895 it was the intention to treat the ore by Ashcroft's wet process, but as this proved commercially a failure the usual method of jigging was adopted. Later, the Cattermole and its development the Sulman-Picard-Ballot process was added for the treatment of the zinc tailing. The capital of the company is £962,500, divided into 550,000 preference shares of £1 each and a similar number of ordinary shares of 15s. each. There are also £79,600 of 5% debentures. The preference shares are entitled to a non-cumulative dividend of 10%, and after 10% has been paid on the ordinary shares both classes of shares rank equally for any further distribution during each year. The dividends paid so far have been: for 1898-9, 10% on both classes of shares; for 1899-1900, 15% on both; for 1900-1, 1902-3, 1903-4, 1904-5, 1905-6, 1906-7, and 1907-8, 5%, 5%, 7½%, 10%, 10%, 10%, and 10%, on the preference alone. For the year July 1, 1908 to June 30, 1909, the period covered by the report just published, both classes receive 10%, it being the first time for nine years that the ordinary shares have participated in the profit. Many reasons have militated against greater profits in the past, the chief of which was the difficulties in concentration. The mill has been entirely rebuilt during the last two years, and is now in full working order. The present report shows a profit of £153,382, out of which £96,250 has been distributed as dividend and the remainder carried forward. The amount of ore treated during the year was 195,332 tons, from which were obtained 42,354 tons of lead concentrate in the jigs and 67,981 tons of zinc concentrate in the flotation plant. The lead concentrate assayed 60% lead, 9·9% zinc, and 32·3 oz. of silver, and the zinc concentrate 42·5% zinc, 11·4% lead, and 16·6 oz. silver. In addition 40,684 tons of old zinc tailing was treated, producing 14,464 tons of concentrate. The slime plant was restarted on June 14, and up to the end of that month 2179 tons were treated yielding 1109 tons of zinc-lead concentrate, assaying 32·5% zinc, 21·4% lead, and 28·2 oz. silver: this awaits further treatment. Of the lead concentrate about one-half was smelted at the company's smelter at Cockle Creek and the remainder sold locally. The smelter also treated about 60,000 tons of purchased ores. Practically the whole of the zinc concentrate was sold. It was found impossible to distil the zinc concentrate on the spot, and the zinc smelting plant was closed in December 1908. The company controls the Central Zinc Company, which recently erected a distilling plant near Hartlepool. This is not yet in working order. The development of the mine at the 1100 ft. level disclosed unexpected ore at some distance from the main orebody. The total reserves are 2,803,920 tons, which is a figure slightly greater than when the company started operations 13 years ago, but it is not expected that the reserves will be maintained in the immediate future, as the lode is contracting in depth.

Wheal Commerce.—This company was formed in 1906 to acquire the old Commerce tin mine near St. Austell, and crushing commenced with 10 stamps in September 1908. Developments have not been satisfactory, for the lode has been cut out by a barren rock the nature of which is a puzzle to the engineers. The directors stop petrographical discussion by calling it 'commerceite.' The work of development is being carried deeper in hopes of getting below the barren ground, and according to latest reports tin-bearing killas have been once more found. In the report for the year ended August 31 it is stated that from the time of starting crushing 6451 tons of ore yielded 65 tons of concentrate, which was sold for £5485. During the succeeding months of September and October 1231 tons of ore yielded 10 tons of concentrate, sold for £878. The directors state that mining cost is low, and give 16s. 6d. per ton as the total average. During October the figure quoted is 14s. 3d. Further details of the work are required before the significance of these low figures can be appreciated. When the present company took over the mine a modern electric installation driven by gas-engines was provided for the purpose of supplying power to the pumps and winding plant. The future of the company depends upon development at depth and as to whether the tin lode gets into the killas again persistently.

Van Ryn.—This mine, situated in the eastern part of the Rand, is now producing handsomely, and the report for the year ended June 30 is the best yet issued. For many years, up to 1904, the general conditions of working on the Rand were not such as would allow the mine to be worked at a profit; now the mine is an important member of the Albu group. During the past year the net profit was £279,386, out of which £225,000 was distributed as dividend. The amount of ore raised was 423,416 tons and after sorting out waste, 358,230 tons was sent to the stamps. This was an increase of 84,448 tons over the previous year. Tube-milling commenced in July 1908 with one mill; a second was put into commission in August; and since September four have been continuously in operation. By amalgamation 99,516 oz. gold were obtained, the recovery per ton being 5·556 dwt. In the cyanide plant 224,579 tons of sand and 123,506 tons of slime yielded 30,402 oz. The assay of the sand was 2·493 dwt. and of the residue 0·448 dwt., while the assay of the slime was 1·988 dwt. and of the residue 0·473 dwt. The total recovery was 129,918 oz. valued at £551,137 or £1. 10s. 9d. per ton. The working costs were £277,663, or 15s. 6d. per ton. The recovery was 5s. 2d. per ton less than during the previous year, owing to large amounts of low-grade ore being milled. By reason of the reduction (6s. 3d. per ton) in costs during the past two years, it has been possible substantially to increase the ore reserve. Approximately 4 dwt. was the limit of pay-ore on June 30, and all richer ore is now included in the reserves, which total 1,419,430 tons and average 6·53 dwt. There is also a reserve of partly developed ore estimated at 337,090 tons, averaging 6·31 dwt. In addition, over three-quarters of a million tons less than 4 dwt. have been developed, and if costs are further reduced some of this will be classed as ore. Recently 20 new stamps have been added, and the 160 already running have been gradually overhauled. Two additional tube-mills are being erected, the sand-plant has been enlarged, and the slime-plant rebuilt. Eventually the amount of ore treated per month will be increased to 45,000 tons, which will be 50% more than during the year under review. Under the improved circumstances costs will be further reduced and the extraction improved, provided that labour supplies are available. Thus a large part of the banket less than 4 dwt. will become available.

Nourse Mines. — This company belongs to the Wernher-Beit group, and owns mines in the central part of the Rand. It is an amalgamation of Nourse Deep and Henry Nourse. In March of this year a further amalgamation was effected by the absorption of South Nourse. The combined property lies to the west of Geldenhuis Deep and Jupiter and to the east of New Goch and City Deep. In March, when the amalgamation was effected, it was decided to add 80 stamps and 3 tube-mills, so that before long the total equipment will be 260 stamps and 7 tube-mills, with a capacity of 700,000 tons per annum At the same time the scale of development operations was greatly extended and two additional haulage-inclines have been sunk. The period covered by the present report is the year ended July 31, and the results of the new policy are shown in the development work, though not yet in the treatment-plant The total ore reserve on July 31 was calculated at 2,100,910 tons with an average assay of 7·1 dwt., and there are other large blocks of ore of lower grade. During the year 441,701 tons were sent to the mill and 115,910 oz. were recovered by amalgamation. The yield was 5·248 dwt. and the tailing contained 2·581 dwt. In the cyanide plant 45,999 oz. were extracted, being a yield of 2·09 dwt. and 0·092 dwt. was left in the residue. The total yield was therefore 161,909 oz. valued at £681,248 ; that is, 7·33 dwt., or £1. 10s. 10d. per ton. This is a decrease in the yield per ton of 0·522 dwt., or 2s. 1½d., as compared with the previous year, but on the other hand 40,504 more tons were milled and the cost per ton was decreased by 1s. 3¾d., total cost having been £445,978, or £1 0s. 2d. per ton. A further source of income was derived from accumulated slime, the treatment of which commenced in December 1908, and the profit to July 31 amounted to £9400. The dividend distributed during the year was £168,750, being 25% of the nominal capital. G. E. Webber is consulting engineer and Percy Cazalet is the manager.

Cordoba Copper.—This company was formed in August 1908 to acquire the copper mines belonging to the Cerro Muriano and the North Cerro Muriano companies in Spain. The management is in the hands of John Taylor & Sons, and William Frecheville is chairman of the company. The present report covers the period from the formation of the company up to September 30 last. The mining, concentration, and smelting problems presented have been by no means easy. The report shows that a great deal of development work has been done, with fairly encouraging results. On September 30 the ore reserve as figured at 122,395 tons, with an average assay of just over 3% copper. The decomposed nature of the country rock makes stoping difficult, and to ensure safety the workings are filled with waste immediately after stoping. During the period covered by the report, 61,486 tons was raised. The preparation of these ores for smelting is not simple. About half of the production is sent to the wet-dressing plant, where 522 tons of concentrate averaging 20·9% copper, and 3128 tons averaging 14·9% copper was produced. The former were sold and the latter sent to the sintering plant, which was described by Henry F. Collins in our September issue. There is also a magnetic separating plant where some of the crude ore, and also the middling from the wet plant, are treated after receiving a preliminary roast. During the period under review 19,627 tons of crude ore and 6971 tons of middling were treated and produced 3155 tons of concentrate averaging 16% of copper. Of this, 124 tons was sold and the rest sent to the sintering plant. Of the remainder of the ore raised, 3000 tons of rich fine was sent to the sintering plant and 2326 tons was picked out and sent to the blast furnace ; the remainder was waste and was discarded. At the sintering plant 8808 tons of smelting material was produced, of which 8755 tons went to the blast-furnace and 53 tons of return fine was briquetted. The average assay of the sintered product was 12·69%. The blast-furnace commenced operations in August 1908, and as its capacity is greater than the supply, it is only being worked every alternate month. During the period under review 10,489 tons of ore have been smelted, made up as follows : 2280 tons of picked ore, 8070 tons of sintered product, 74 tons of screened fine, and 65 tons of briquettes. In addition, 1073 tons of slag has been re-smelted, the fluxes added amounted to 6274 tons, and the coke consumed to 2360 tons. The



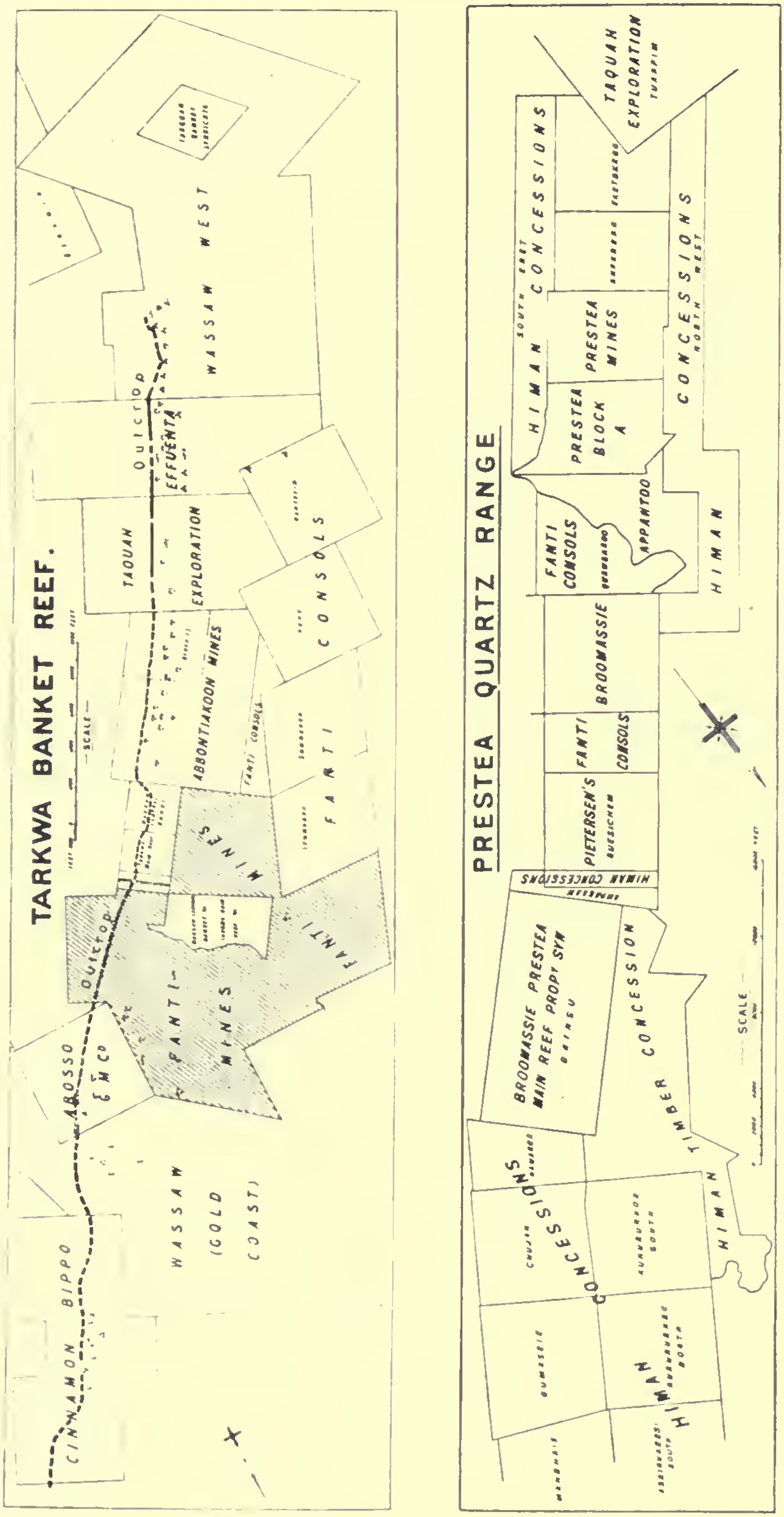
A PART OF THE WITWATERSRAND.

product of smelting was 1838 tons of matte assaying 62% copper and 69 tons of bottoms assaying 85 to 90% copper. The directors report that the magnetic process is expensive in repairs and renewals, and that it is not easily kept in an efficient condition. The wet-dressing plant is not at all up-to-date, and a modern one is now being erected. The ore was tried in the Elmore vacuum plant, but owing to the presence of so much calcite the results were not satisfactory. For some months parcels of the ore have been sent to the Murex Magnetic Co's plant at Millwall, and the preliminary tests have been sufficiently encouraging to warrant the erection of a small experimental plant at the mine. As regards the financial position of the company, the profit and loss account on September 30 showed receipts from sales of ore and matte of £65,102 and a total income of £76,873. Against this the expenses at the mine and in London were £73,462.

Copiapo.—The report of the Copiapo Mining Co., operating the Dulcinea copper mine in Chile, for the year ended June 30, shows that the business of the company is not in a promising condition. This company was originally established in 1836, and for a great many years made good profits. Three years ago the control passed into the hands of the Siemens group. Additional capital was subscribed with the object of developing the property and erecting modern smelting plant. J. H. Cordner-James is chairman and L. C. Stuckey was recently appointed manager. During the year ended June 30 the amount of ore smelted was 11,374 tons averaging 8·4% copper, which produced 1343 tons of matte assaying 51½% copper and containing also 428·7 oz. gold and 9766 oz. silver. Some of this ore was pyritic and some oxidized; no mechanical dressing is done, but some waste is picked out by hand. The receipts from the sale of matte were £33,631, and the loss on the year's working was £25,893. If it had not been for the action of Henrik Loeffler, one of the largest shareholders, in advancing £26,000 with practically no security, the company's finances would have been seriously embarrassed. The company has a share capital of £225,000 and a debenture issue of £50,000, and no money could have been raised by temporary loans on security, so that Mr. Loeffler's course partook of the generous. Smelting is far from perfect, and the height of the blast-furnace is to be increased with a view of decreasing the consumption of coke, which is an expensive item. In June last, damage and interruption were caused by an earthquake. On June 30 the ore reserves were 21,757 tons of oxidized ore and 39,234 tons of pyrite, a total of 60,991 tons averaging 7·19% copper. The amount developed during the year was approximately equal to the consumption. The directors do not take a cheerful view of the future, and hardly hope to make a profit unless the price of copper rises.

Cinnamon Bippo.—This company owns property two miles long covering the northern part of the Tarkwa banket, and the control has lately been acquired by the Consolidated Gold Fields of South Africa. The work during the year covered by the present report has consisted entirely of development. The deposit has been proved to be of rather lower grade than the other parts of the Tarkwa deposit, but the content is more regular and continuous. Over the whole property the outcrop is found to be auriferous. Walter Broadbridge, who was recently appointed manager, estimates that the ore so far developed contains 213,000 tons running from 5·2 to 9·8 dwt. per ton, and averaging 8 dwt. The consulting engineer, H. H. Webb, considers that ore containing less than 6 dwt. could not be profitably worked, and he has revised the estimate to 133,000 tons averaging 9·3 dwt., and 80,000 tons of unpayable ore averaging 5½ dwt. Trouble has been experienced from the inflow of water, and extra pumps have been provided. Mr. Broadbridge has recommended that a new main incline-shaft shall be sunk, and operations have been commenced. Eventually another similar shaft will be required. The question as to the size of the mill is still in abeyance. Henry Hay has been appointed as a joint manager with Mr. Broadbridge of all the properties in West Africa under the control of the Consolidated Gold Fields.

Ashanti Goldfields.—The report of the Ashanti Goldfields Corporation is one of exceptional interest for two reasons. In the first place it records important developments, and secondly the account of the mine and of the metallurgical treatment written by W. R. Feldtmann, the consulting engineer, is both lucid and complete. Started 13 years ago, the corporation has had varying fortunes. In 1908 the discovery at Justice's not only added to the corporation's assets, but directed attention once more to the possibilities of the ore deposits in West Africa. A year ago the known deposits at the Ashanti mine were such that Mr. Feldtmann considered it a low-grade proposition that should be worked on a large scale and with consequent reduced costs such as would allow of the inclusion of poor ore in the reserves. Additional plant on an extended scale was therefore erected. During the past year a remarkable change has come over the mine, especially in the orebody under the old Obuasi workings. Here great bodies of high-grade ore, in places 8 ft. wide and exceeding 3 oz. per ton, are being developed; and it is obvious therefore that the whole complexion of the undertaking is changed. The enlarged mill will not now be used on low-grade ores, but it will be available for the treatment of the high-grade stuff on a large scale. The corporation's report covers the year ended June 30, and shows that 70,345 tons of ore yielded 41,014 oz. gold valued at £174,368, with a gross profit of £85,260. After paying royalties of £8718, London expenses £5101, debenture interest £5412, and allowing £13,893 for depreciation and £9154 for mine development redemption, a net profit of £44,792 was made. The directors also report that most of the debentures have recently been exchanged for newly issued shares. The issued share capital now stands at £196,000, and the debentures are practically extinguished. Mr. Feldtmann's report covers the twelve months from November 1908 to October 1909, during which time 79,010 tons yielded gold to the value £201,287. With regard to the metallurgical processes, the most important item is that amalgamation was entirely abandoned in September. This method of extraction was never a success even when the oxidized ores were being treated. On the lower levels sulphur and arsenic appeared and also graphite, so that the extraction became still worse and some other method of treatment had to be sought. Dry-crushing in ball-mills, roasting in Edwards furnaces, and leaching by cyanide were adopted, and the first part of the plant was erected early in 1907. This was doubled in 1908 and at the present time an entirely new plant to supersede these is being erected. Thus an extraction of 90% is obtained. At Justice's the metallurgical problem is different, for the ore is of a soft clayey nature instead of consisting of quartz. The method of treatment is to crush in the stamp-mill, using a cyanide solution, and subsequently to separate the sand from the slime, the latter predominating. The sand is treated by percolation and the slime is treated by agitation and filter-pressing. The sulphide ore at Justice's requires much longer roasting than the quartz sulphides, and the best treatment will be investigated



MINES IN THE PRESTEA AND TARKWA DISTRICTS, WEST AFRICA.

when the completion of the new plant releases the old plant and leaves it free for experiments and investigations. This will happen next June. The ore reserves at the end of October totalled 519,300 tons averaging 18·2 dwt. Of this 88,000 tons were in the Obuasi shoot and averaged 47 dwt. per ton. The profit on these reserves is estimated at over one million pounds.

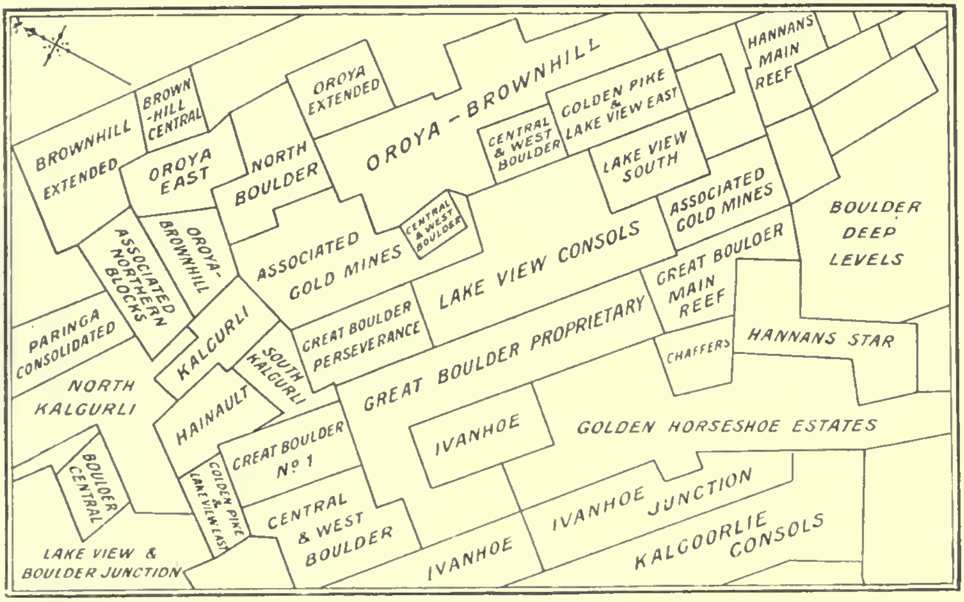
Edmundian Copper.—This company belongs to the Consolidated Gold Fields group and operates a copper mine in Mozambique territory, close to Rhodesia and adjoining the Beira-Salisbury railway. The copper occurs as chalcopyrite, which is exceedingly friable. The content is fairly regular, but the vein varies in width; though in many cases the average is over 15%, a lower content is used in estimating the value of the ore actually mined, 9·8% being the figure adopted at present. The ore as it comes from the mine is hand-picked on belts, rich ore being taken out on one side of the belt and barren rock on the other. The discharge from the end of the belt averages from 4 to 5% copper. It is sent to stamps, where it is crushed to pass through a screen with 300 holes per square inch, and is afterwards concentrated in an Elmore vacuum-plant. The concentrate here obtained runs from 20 to 22% copper and the tailing contains about 1%. The ore and concentrate are smelted in a reverberatory, where a matte averaging 50 to 60% is obtained. The engineers have not been able to get as much work out of the crushing plant as they expected, for some reason not explained. Three air-cushion stamps are in use, each with an estimated capacity of 20 to 25 tons per day. The engineers could not get more than from 11 to 12 tons per day through each stamp, so that the duty was only 35 tons instead of 60 to 70 tons as expected. The capacity of the reverberatory furnace has also been less than was expected. Modifications are therefore being introduced into the crushing and the smelting plants. In future the fine ore is to be removed before crushing and the coarse ore will be sent through the air-cushion stamps with a larger aperture and subsequently through a Chilean mill. In addition to the reverberatory, a blast-furnace is being erected. It will be designed to use pyritic smelting, and it will treat the slag from the reverberatory and the coarser parts of the ore. The company was formed in 1907 and operations commenced toward the end of 1908. The present report covers the nine months ended June 30. From October 1908 to June 30 the production was 569 tons of matte which sold for £15,749. Since the latter date to the end of November the output was 400 tons matte. The expense at the mine for the 9 months was £17,867, which shows a loss, but when the new crushing and smelting plants are completed the balance should be on the other side. The ore reserve on June 30 was 26,965 tons, averaging 9·8% copper.

Cape Copper.—This company was formed in 1863 to acquire the O'okiep mine in Namaqualand, South Africa, and for many years made handsome profits out of high-grade bornite and chalcopyrite, which was and is still shipped to Britonferry, South Wales, for treatment. For some time it has been known that the reserve of ore is limited, and other properties have been acquired or tested in Africa and elsewhere. The report for the year ended April 30 in Cape Colony and August 31 in London and Newfoundland shows a profit, before paying income tax, of £90,223, which is only one-half of the average of the last 20 years, and £50,000 less than last year. The low price of copper is accountable for most of the fall, as may be judged from the fact that two or three years ago the profits were four times as great as during last year. Another reason for the fall of profits was a strike at the Britonferry works lasting for 13 weeks. During the year, sales of copper brought in an income of £187,914. The company owns shares in the Tilt Cove Co. of Newfoundland, and treats its ores at Britonferry. The profit from this source was £10,661. Other items brought the income to £205,700. Mining, smelting, and investigations cost £106,736, London and other expenses brought the total cost to £115,456, leaving a balance of £90,223. Taxes also absorbed £26,148, so that the balance available for distribution was £64,075. As a large balance, £74,864, was brought forward from the previous year, it has been possible to distribute £12,375 on the preference shares, which is at the rate of 13¾%, and £82,500 on the ordinary shares, at the same rate. During the year 15,968 tons of ore assaying 15·45% were obtained from the O'okiep mine, leaving a reserve of 10,000 tons. The Nababeep mine yielded 54,000 tons of ore assaying 5·04% and the reserve is 150,000 tons, practically the same as a year ago. Trial workings have been conducted at the Narrop, Springbok, and other mines in the district, with moderate results. Details of operations at the properties under option in America and India are not given.

Glen Deep.—This is one of the smaller 'deep levels' of the Rand belonging to the Wernher-Beit group and has recently been absorbed by its neighbour Rose Deep. The report for the year ended July 31 shows that 290,372 tons were mined, and after 29,527 tons of waste had been removed, 260,845 tons were sent to the mill. There are 100 stamps in operation, so the duty was just over 8 tons per day. The ore as delivered to the mill assayed 6·955 dwt. The yield was 4·189 dwt. and the tailing assayed 2·95 dwt. The total yield was 54,703 oz. After passing through tube-mills the tailing was cyanided, which extracted 34,073 oz., or 2·597 dwt. per ton, and 0·439 dwt. was left in the final residue. The revenue from the sale of gold was £373,431, or £1. 8s. 7d. per ton, and the working cost was £251,691, or 19s. 3d. per ton. The profit was therefore £121,739, out of which £120,000 has been distributed as dividend. According to H. S. Martin, the consulting engineer, and C. Glyn, the manager, the reserve of payable ore amounts to 803,113 tons averaging 6½ dwt., an increase of 267,000 tons during the year. Much of this increase was due to recent developments, but it was also due in part to the inclusion of blocks of ore hitherto considered to be too low-grade. There is also low-grade stuff amounting to 395,000 tons averaging 3·1 dwt. which at the present time is of no value. The yield decreased by 1s. 10d. per ton as compared with the year before, and the cost was reduced by exactly the same figure. This mine commenced operations in 1898. The capital is £600,000, of which 366,000 shares were issued as purchase price and 234,000 shares were sold for cash at various times, yielding working capital amounting to £386,246. Sale of gold has produced £2,590,764, and £510,000 has been distributed.

Simmer & Jack East.—This company belongs to the Consolidated Gold Fields group, being an offshoot of the Simmer & Jack. It owns the deep levels to the south of Rose Deep, Glen Deep, and Knights Deep, and the development of the metallurgical problem has been effected conjointly with Knights Deep. Milling was commenced in 1905 with 200 stamps, of which 70 have since been leased to Knights Deep. There are also three tube-mills and a cyanide plant. During the year ended July 31 the average number of stamps running on Simmer & Jack East ore was 145, and the amount of ore milled after the sorting out of waste was 385,440 tons, the stamp-duty being 7·946 tons per day. The recovery of gold at the battery was 47,506 oz.; on the tube-mill plates, 20,080 oz.; in the sand-plant, 25,914 oz.; and in the slime-plant, 8718 oz.; a total of 102,218 oz. valued at £430,410, or £1. 2s. 4d. per ton. The cost was £355,418, or 18s. 5d. per ton, leaving a profit of £75,261 or 3s. 11d. per ton. It will be seen that the gold content is low; and every effort is being made to develop the deeper levels in the hope of finding a better grade of ore. The mine also has the difficulties attending broken and faulted ground, and dikes have cut out much of the reef. The sinking of the incline through the dike encountered below the 12th level was tedious work, but in December the reef was intersected to the south of the dike, and it is hoped that this part of the mine will give more regular and better results. The reserves at the end of July were estimated at 728,000 tons assaying 5·8 dwt., and until further development has been done at the lower levels it is deemed advisable to continue to lease the 70 stamps to the Knights Deep. The metallurgical treatment at reports the reserve of ore on July 31 to be 430,000 tons to the 1500 ft. level, and exploration work has pointed to the existence of other ore below. During the last year or two more money has been spent in development work, as the indications at depth rendered such a policy desirable. During the past year the additional ore developed has not been equal to the amount extracted. Since the publication of this report the finds at the 1550 ft. level have been of a more satisfactory nature and point to the continuation of the orebodies in a manner encouraging to shareholders.

Knights Deep.—This is one of the mines on the Rand belonging to the Consolidated Gold Fields group, and adjoins Glen Deep. The present report covers the year ended July 31. During this period 593,990 tons were sent to the mill and the yields in the battery, tube-mill plates, sand-plant, and slime-plant, were 83,947, 23,897, 50,966, and 9884 oz., respectively, a total of 168,694 oz. valued at £709,549, of



THE GOLDEN MILE, AT KALGOORLIE.

Simmer & Jack East is of interest, as it was here that screens with only nine holes to the square inch were first used in the battery. With stamps weighing 1400 lb., the output per stamp per day was raised to 15 tons.

Kalgurli.—The production of gold from the Kalgurli mine at Kalgoorlie, West Australia, has been remarkably regular during the last four years, the average having been £350,000, and during the past year, ended July 31, £344,761. The amount of ore raised and milled was 128,220 tons during the year, with a recovery of £2. 14s. 0d. per ton. The residue contained gold to the value of 3s. 3½d. per ton. The extraction was 94·39%. The cost of mining was £51,592 or 8s. per ton, and the cost of ore treatment was £74,781, or 11s. 8d. per ton, a total of 19s. 8d. In addition, £26,319 was spent on development, and £13,506 was allowed for depreciation. London expenses, taxes, etc., came to £18,704, so that the balance of profit was £159,857, out of which £150,000 was distributed as dividend. The total production since the commencement in 1897 has been £2,209,682, out of which £870,000 has been distributed in dividends. R. S. Black, the manager, a yield of £1. 3s. 10d. per ton. The operating expense was £429,065, or 14s. 5d. per ton, leaving a profit of £281,306, or 9s. 5d. per ton. The dividend distributed absorbed £257,410, which is at the rate of 40%. The ore reserve at the end of July is estimated at 1,529,000 tons averaging 6 dwt. In this figure is not included any ore from the 'Bastard reef,' which is too erratic in value to warrant an exact estimate. There is no doubt, however, that much of it can be milled profitably; in fact, some of it has been treated during the past year. Only a limited amount of development work remains to be done on the property owing to the flattening of the reef in the lower levels. No further incline-sinking will be necessary, so that the development cost will gradually be eliminated. During the year the 200 stamps belonging to the company have been supplemented by 70 borrowed from Simmer & Jack East. A fifth tube-mill has been added, as has also been a 'black sand' plant to be used for catching the auriferous pyrite, which with the greatly increased output of the stamp-mills cannot now be caught on the plates.

Camp Bird.—This company published a prospectus on January 3, offering for subscription £500,000 of 6% debenture stock at 97½ and 280,000 of £1 shares at £1. 7s. 6d. The object of this new issue is to enable the Camp Bird company to finance the recently formed Santa Gertrudis Co. The capital of the latter company is £1,275,000, of which the Camp Bird will acquire by purchase 1,155,822 shares, £259,631 being provided out of the reserve fund and the remainder out of the present issue. The Santa Gertrudis Co. was formed to acquire the controlling or aviadora rights of the silver and gold mine of that name in Pachuca, Mexico, and the purchase price is nine million pesos, or £922,131. After this price is paid the company will have a working capital of about £150,000, which will be spent in further developments in depth and the erection of a modern mill and cyanide plant to treat 160,000 tons per annum. The mine was discovered in 1876 and has been worked successfully by a local company, although the methods of treatment are out-of-date and expensive, the patio process of extraction being used. The adjoining mines working on the same vein, La Blanca and Barron, have also been successful. The Santa Gertrudis vein is large and persistent. It consists of friable quartz, and the valuable mineral is sulphide of silver which contains some gold. There are practically no base metals present, so that cyaniding will give high extractions. The country rock is andesite. The vein varies from 10 to 30 ft. in width and has been developed for more than a mile in length. The main ore-shoot has averaged 2500 ft. extending through the three mines. Within the Santa Gertrudis ground there is another smaller orebody, and the indications are that this will join the main orebody in depth. The main shoot has been worked down to the 1000 ft. level. The average content of the ore now available for stoping is 32 oz. silver and ¾ dwt. gold, and the average value is about $20 (American) per ton. The mine has been carefully sampled, and it is reported that there is 308,043 tons of 'positive' ore that will yield $2,565,055 profit and 218,240 tons of probable ore that will yield $2,714,906. The cost of treatment by a modern plant will be about $11. The petrological examination of the vein and country rock shows nothing to indicate any change in depth. The examination of the property was undertaken by W. J. Cox, manager of the Camp Bird, E. E. Chase, of Denver, did the sampling, F. J. Pope made the geological report, G. D. Doveton advised on metallurgy, E. E. McIntyre, of the Guanajuato Development Co., reported on the cost of mining, and R. J. Frecheville, one of the directors, has visited the property and given his views.

The issue of these shares and debentures is an assured success, as it has been underwritten partly by L. Hirsch & Co. and partly by the Canadian Agency Limited, one of Chaplin, Milne, Grenfell & Co.'s companies. The underwriting commission is 5% on the debentures and 2s. 6d. on each share. The subscribers to the debentures will have the option of taking up shares in exchange for debentures any time before 1913, at the rate of 35s. per £1 share, and after 1911, £100,000 every year is to be set aside out of profits for the extinction of debentures.

The Camp Bird company was formed in 1900 and the paid up capital is £820,000. The present issue of 280,000 shares and 250,000 shares held in reserve for exchange from debentures brings the share capital to £1,350,000; besides which there are the newly issued debentures of £500,000. Since operations commenced, the shareholders have received £1,107,000 in dividends. It is estimated that at the Camp Bird mine there is still £472,274 profit in the reserves.

Stratton's Independence.—This company has issued its first report since reconstruction on September 8, 1908. During the year ended June 30, 1909, the amount of ore raised by the lessees was 38,082 tons of which 21,162 tons was picked out and shipped to the smelters. The gross value per ton was $26·04, and freight and treatment came to $7·42, leaving a net revenue of $18·61. Of this net revenue 35·9% went to the company and the remainder to the lessees. The income of the company from this source was £32,360. The wet mill for treating the dump ore re-started on April 1, and during the three months to June 30 made a profit of £1037. The net profit was £13,221. Out of this £6250 is being paid as dividend, which is at the rate of 5% on the capital, and the directors at the same time declared a similar dividend on account of the current year's operations. Development of the mine was recommenced in November 1908 with the object of extracting medium-grade ore from the caved workings. This ore was to be crushed coarsely, the fine containing the telluride being screened out and roasted. The trial operations were not successful because the capacity of the roasting-furnace was much greater than the possible supply of ore. Philip Argall, the consulting engineer, is now engaged in elaborating an alternative plan for treating this ore without roasting. Trouble was also encountered when starting the wet mill in April 1908 on the low-grade ores, for it was found that the average content was 26% less than was estimated when sampling the dumps. This made all the difference between profit and loss in treatment, so operations were suspended. Investigations were then made with a view to finding the richest parts of the dumps, and subsequently the plant was re-started on April 1 last. During the three months to June 30, the ore treated amounted to 12,265 tons averaging $4 per ton and yielded 158½ tons of concentrate containing 4·235 oz. per ton and 221 tons of concentrate containing 1·186 oz. per ton. The mill is now treating from 6500 to 7000 tons per month at a cost of $1·52 per ton, and another Chilean mill will shortly increase the capacity to 10,000 tons per month.

Tanganyika Concessions.—The report of this company covers the year ended June 30 last. The company owns 45% of the shares of the Belgian company, Union Minière du Haut Katanga, the chief assets of which are the Star of the Congo and the Kambove copper mines; also 65% interest in the Kansanshi copper mine over the border in Northwest Rhodesia and a number of other concessions in mid-Africa. The copper deposits are extensive, but owing partly to the fact that they are carbonates and partly to the want of necessary transport facilities, operations on a commercial scale have been hindered. In November the railway from Bulawayo was completed as far as the Congo State border and it is expected that the Star of the Congo mine will be reached in October next. Some progress has also been made in the construction of the line from Benguella. As regards the copper deposits, it is stated that the developed ore at the Star of the Congo contains 50,000 tons of copper and the Kambove 250,000 tons, and the 'probable' copper at the two mines is given as 600,000 tons. The plant now in course of erection is calculated to produce 1500 tons of copper per month. Neither the report nor the speech at the shareholders' meeting by Robert Williams contained any precise statement as to the measure of success achieved in the trials with the metallurgical process finally adopted, and no information was given relating either to the cost of production or the percentage of extraction. The future prospects were described in vague and general terms.

BOOKS REVIEWED

THE COST OF MINING.—By James Ralph Finlay. 8vo. 415 pages. Published by the McGraw-Hill Book Co., New York. Price 21s. For sale by *The Mining Magazine*.

This book carries the sub-title: "An exhibit of the results of important mines throughout the world," and, in effect, it analyses the annual reports of different forms of mining enterprise by the light of the author's own experience in American mines. Mr. Finlay is a graduate of Harvard and a mine superintendent who has had charge of important mines in Michigan, Colorado, and Missouri; a few weeks ago he was appointed general manager of the Goldfield Consolidated, one of the great gold mines of the world. Obviously therefore he is well-fitted to write on the cost of mining and to institute useful comparisons. Bu' he lacks personal acquaintance with mining outside of the United States, and to this extent his comment must suffer as an authoritative dictum. The book makes an excellent companion to Mr. Hoover's recent volume on 'The Principles of Mining.' Mr. Finlay goes into greater detail and gives more copious information than Mr. Hoover, but he lacks the bird's eye view of world-wide mining that marks the utterances of the younger author. Both books are real additions to the scanty literature of mining in its most practical, and therefore commercial, aspects. To emphasize this side of the subject, Mr. Finlay had written a number of valuable articles in the *Engineering and Mining Journal* and the *Mining and Scientific Press*. It is these technical contributions that form the foundation of his book, which is the work of a busy mining engineer, not a professor; hence what it lacks in literary finish, it gains by contact with facts. Most readers will not mind errors due to careless editing, but a critic is bound to draw attention to the glaring misprints appearing, for example, in the Preface. Mr. Hoover was credited with lectures at Stamford University; Mr. Finlay is debited with not knowing how to spell the name of James Douglas.

The scope of the book may be indicated by the headings of a few chapters. 'Value of mining property,' 'Occurrence and production of copper,' 'Silver-lead mining,' 'Occurrence and production of gold,' 'Silver mining at Cobalt and Guanajuato,' and so forth. On some matters the author has precise and personal knowledge; as to others he compiles as best he can. In analysing mining costs in the copper mines of Michigan, the gold mines of Colorado, the silver-lead mines of Idaho, the iron mines of Minnesota, etc., he is on firm ground, and these subjects compose three-fourths of the book. As to the Rand, Mexico, Australia, and India, he utilizes the trustworthy data and comments previously submitted by such men as Curle, Leggett, and Hatch. As he says in the preface, most of the material submitted has been available before, but only in detached form, out of focus, and without the illumination of a comprehensive outlook. This Mr. Finlay supplies and the result is that dead figures are made to convey a true story. No earnest student of mining, whether young or old, a novice or a veteran, should miss a careful reading of 'The Cost of Mining.'

T. A. R.

A BOOK OF PRECIOUS STONES.—By Julius Wodiska. Cloth, 8vo. 370 pp., with coloured plates and other illustrations. New York and London: G. P. Putnam's Sons. Price 10s. 6d.

The number of available books on precious stones has always been small. At the present time Streeter's and Kunz's are out of print, and we regret to hear that Bauer & Spencer's monumental treatise will within a short time follow them. The present volume is not quite of the same class as these three. It is an account of stones from the trade point of view, and their handling and application, rather than a scientific disquisition, but owing to the scarcity of books on the subject it is none the less a welcome addition to the literature. It has another feature not possessed by most books, in that it contains chapters on the manufacture of jewelry and gives considerable information about the arts and crafts movement in America, describing the work done at the various schools where the art of the goldsmith and the jeweler is taught. The diamond-cutting industry is described in detail, as is also the social and economic position of the cutters. These parts of the book are really better than the chap'ers devoted to the description and origin of the various stones, and we expect that the book will gain 'ts vogue on account of this feature. As the author's own experience has been in the jewelry trade it is obvious that he is qualified to give interesting information from this point of view. His chapter dealing with the technical nomenclature employed in marketing stones is useful. Like all people connected with the trade he adopts the somewhat loose method of description so irritating to the dilettante. For instance, he chooses to include all red stones under rubies, a custom unfortunately prevalent amongst sellers but regretted by everybody else. He sees no reason for closely differentiating between real ruby and spinel, and leaves the reader in doubt whether a Siam ruby is corundum or spinel. A prejudiced trade opinion is that "corundum gems are as beautiful by artificial light as by daylight;" but we beg to protest that the sapphire does not possess this characteristic, being a decided failure at night. The book is made interesting by the inclusion of a particularly full bibliography.

SOCIAL ENGINEERING.—By William H. Tolman. Cloth, 8vo. 384 pages. Ill. New York: McGraw Publishing Company.

It is unusual to designate by the term 'engineer' one whose work is chiefly diplomatic. But as the duties of the 'social engineer' or 'social secretary' are to increase the 'mutuality' between employer and worker, and thus to increase the efficiency of labour, the name is well chosen.

This new profession originated in France but came into actuality in a New England department store by the employment of a woman 'social secretary' about the year 1901. The duties of the profession, as set forth by the author, range from the examinations of suggestions from workmen; the building of $100,000 baths, where employees bathe without cost or loss of time during working hours; the managing of temporary hospitals with doctor and nurse on hand during the day; to the management of technical schools; and the arrangement of free trips to manufacturing centres for instruction, or to summer-resorts for recreation for parties of employees. An important part of the duties is the study and selection of safety-appliances and safety-methods in order to lessen the losses by accidents, which have cost the United States more than £50,000,000 annually. Other subjects considered by the author as coming within the sphere of this profession are hygiene, thrift, profit-sharing, housing, and communal betterment.

As of interest to the mining profession we note the premium' method of wage-payment by which a price and a time-limit is set for a given piece of work, and the time saved by the workman is paid for in addition to this price. We may confidently look for the 'social engineer' to grow in numbers and influence.

W. H. S.

CURRENT LITERATURE

Chart of Igneous Rocks.—In the *Mining and Scientific Press* for October 30, Stuart Croasdale presents a simplified table of igneous rocks founded on F. W. Clarke's 'Data of Geochemistry,' one of the U.S. Geological Survey bulletins.

Specific Gravity of Bisulphate of Soda.—At the September meeting of the Chemical Metallurgical and Mining Society of South Africa, T. Donaldson presented a table for determining the specific gravity of bisulphate of soda solutions used in dissolving zinc from the precipitate.

Recovering Zinc in Cyanidation.—W. Cullen and G. F. Ayres read a paper at the September meeting of the Chemical Metallurgical and Mining Society of South Africa in which they described their proposed method of recovering the zinc dissolved out by bisulphate of soda. It is estimated that on the Rand, zinc to the value of over £100,000 is used every year, and it is all allowed to go to waste. The authors propose to precipitate it as hydrated oxide by adding calcined magnesia.

Estimation of Arsenic and Antimony.—In the *Engineering & Mining Journal* for November 27, Walter C. Smith describes the Knorr distillation apparatus used in making separate determinations of arsenic and antimony. The process is useful in connection with copper and lead products, but is not satisfactory when tin is present.

Study of Outcrops.—W. H. Emmons commences a series of articles relating to the study of outcrops of orebodies, in the *Mining & Scientific Press* for December 4, discussing in detail the occurrences and phenomena of weathering, erosion, enrichment, and other changes.

Copper in Alaska.—In the *Mining & Scientific Press* for December 4, G. A. R. Lewington describes the copper deposits of the upper White River district in the Wrangell mountains, Alaska. The copper occurs native in amygdaloid rocks.

Arizona Copper Deposits.—In the *Mining & Scientific Press* for November 27, C. F. Tolman, jr., continues his articles on the copper deposits of Arizona, dealing in this issue with the Silverbell district, 35 miles west of Tucson.

Tunnel-Driving in Colorado.—In the *Mining & Scientific Press* for December 4, H. Foster Bain writes of various adits in Colorado just completed or on the point of completion. Details are given of the Newhouse, Roosevelt, Cripple Creek and Gunnison tunnels.

Shaft-Sinking through Sand.—In the *Engineering & Mining Journal* for December 11, F. W. Adgate describes the sinking of a shaft for the Cleveland Cliffs Iron Mining Co., Michigan, through 60 ft. of water-bearing sand and gravel. A circular caisson, with cutting edge, was employed, similar to such as are used in subaqueous foundations. A rectangular shaft of reinforced concrete 15 ft. 4 in. by 11 ft. 4 in. was built inside.

Guanajuato District, Mexico.—In the *Engineering & Mining Journal* for December 4 there is published a map of Guanajuato district containing the names of all the mineral claims.

Electric Signalling in Mines.—In the *Monthly Journal* of the West Australia Chamber of Mines, C. E. Grayson describes the system of electric signalling installed at the Main and Edwards shafts of the Great Boulder Proprietary mine.

Native Copper and Cassiterite.—At the November meeting of the Mineralogical Society, J. B. Scrivenor read a note on the occurrence of native copper with cassiterite. At the Rotan Dahan mine in Kinta, Perak a reddish material was found attached to the cassiterite. On examination this was found to be native copper in minute sharp crystals. The tin occurs in decomposed schist overlying limestone, and the copper was probably reduced in place from solutions flowing through the schist.

Zeehan Silver-Lead District. — The *Australian Mining Standard* for November 17 publishes the preliminary report on this district by the Government geologists, W. H. Twelvetrees and L. K. Ward. Briefly their view is that the lodes are not shallow secondary concentrations, and they consider deeper workings to be warranted.

Mother Lode Mine, B.C.—R. H. Allen, in the *Engineering & Mining Journal* for December 4, describes the method of mining at the Mother Lode copper mine at Deadwood, near Greenwood. The ore is complex, containing chalcopyrite, magnetite, and pyrite, with small quantities of blende and galena and perhaps 1 dwt. of gold per ton. The ore occurs as a series of large bodies at the contact between limestone and a green epidote rock. The cost of mining is low.

Design of Smelter Flues.—In *Mining Science* for December 16, F. A. Lee describes the design and method of construction of the various types of smelter flues used in Colorado.

Loss of Gold in Cupellation.—In *Mining Science* for December 16, G. A. Easley and C. W. Keniston describe experiments undertaken to ascertain the loss of gold in cupellation when tellurium is present. Similar work has been done by Hillebrand and Allen and by Holloway and Pearce. The present authors find that the loss of gold is no greater than if tellurium were absent as long as the temperature is less than 730°C. At temperatures from 870° to 970°C, the increased loss of gold due to the presence of tellurium is comparatively great.

State Smelting Works.—In the October, November, and December issues of the *Queensland Government Mining Journal*, there is reproduced the report of C. F. V. Jackson, chief inspector of mines, on the proposal to establish a State smelter. There are a great number of small mines producing gold, copper, and silver-lead concentrates in Queensland, and there is a general feeling that the prices obtained by selling these to smelters in the State or in New South Wales are not good enough, and that consequently mining operations are under a disadvantage. Mr. Jackson, after exhaustive enquiry, does not think the State could do the smelting any cheaper. The report is of interest, because it enters into full details relating to the various producers and smelters, and the terms of business usually adopted between the parties.

The Garfield Ore Tramway.—The gravity tramway that brings the cupriferous porphyry ore from the Boston Consolidated mine down to the Garfield concentrator is described in *Mines & Minerals* for December by Louis S. Cates, mine manager of the Boston Consolidated company.

Stadia Chart.—In *Mines & Minerals* for December, E. B. Tinker, chief engineer of the Miami Copper Co., describes a chart used for stadia calculations as a substitute for the usual tables.

Radio-activity of Carnotite.—In our issue of November we gave a précis of a paper dealing with the production of vanadium and uranium from carnotite in Colorado. In the Colorado *School of Mines Quarterly* for October, H. Fleck and W. G. Haldane give further particulars of this subject, and describe and illustrate the plant employed. They also give particulars of investigations relating to its radio-activity.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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CONTENTS.

REVIEW OF MINING

POLITICS.—Now that the General Election is over, it is likely that more attention will be given to mining affairs. It is surely an anachronism that an election over a comparatively small area should be spread over two weeks and that for half a month the business of the country should be upset by the alarums of the politician. Of course, as good citizens the mining fraternity has taken a keen interest in the event; although only one mining engineer, Mr. J. Norton Griffiths, has been returned to the new House of Commons, several representatives of the industry were elected, notably Messrs. J. G. Hancock and Albert Stanley, both of whom have served their time in coal mines. Moreover, many engineers participated actively in the election, chiefly by using their motor-cars. Indeed the engineering feature of the election has been the intensified use of the motor-car in facilitating canvassing and polling. It may be that the tax on petrol stimulated motorists to oppose the Budget ; it may be that it was undiluted patriotic spirit that energized them into swift movement. By the aid of the modern self-propelled road-vehicle the plural voter has been enabled to flit about the country, hence that supposedly most intelligent member of the community has impressed himself emphatically on the constituencies. It is illegal to give a railroad ticket to a voter ; it is legal to expend petrol in transporting him to the polls. Whatever view may be taken of this anomaly, it is certain that the recent election accentuated the growth of the motor-car industry and the influence of the engineer on political institutions.

The floods in France, especially at Paris, have elicited worldwide concern, and the damage to property incidental to this inundation has depressed the money markets. While a loss of £40,000,000 may lead to activity in the special industries contributing to the repairs and restoration of a devastated city, the destruction of so much capital is sure to be felt on the stock markets. While the Seine was rising the African share - list was falling, especially during the few days when telegraphic communication was interrupted.

TRANSVAAL.—The profit from all the mines in 1909 is announced at £12,074,302; the dividends paid by the gold mines amounted to £9,238,396, which is £668,480 more than in 1908. In 1904 the dividends aggregated only £3,937,624, and the steady increase since then speaks eloquently for the healthy growth of the industry. The December statistics indicate a curtailment of development owing to an inadequate supply of labour, although the more recent increase in the supply of natives is deemed encouraging, especially as the news from the recruiting centres is of an optimistic character. But the danger exists, and will continue to exist, despite the sanguine hopes of operators with one eye on the mines and the other on the share market. Meanwhile, it is pleasant to record the re - starting of the Geduld mill on the strength of a better supply of natives ; on the other hand, the inviting of tenders for the new 240-stamp mill of the Brakpan suggests the increasing demands for labour as development progresses. It is also announced that an arrangement has been made between the Transvaal and Cape governments for the establishment of a labour registry, and that special facilities are to be afforded for the shipment of natives by rail to the Rand.

The directors of the New Modderfontein company announce the completion of an arrangement with the Transvaal authorities whereby the mining rights under water-rights on 47·4 reef-bearing claims are obtained on condition of paying 4·666% of the company's profits to the Government. In order to increase the capacity of its plant to 1,000,000 tons per annum, it is now proposed to issue 50,000 shares at £11 each. It is estimated that this £550,000 will suffice to increase the milling plant, electrify the machinery, and advance the development so as to create a reserve of 5,000,000 tons of ore within two years. This new departure is an event of general interest as indicating the stability of the gold mining industry of the Rand. The New Modderfontein owns 1271 claims or 888 acres containing gold ore, while the adjacent Modderfontein B company has 1400 claims, equal to 952 acres. A claim is estimated to yield from 20,000 to 23,000 tons of ore, so that each company has a reasonable probability of producing about 25,000,000 tons of ore, after making deductions for faulted ground. Both mines have a life of at least a quarter of a century, at the rate of 1,000,000 tons of ore and about 400,000 ounces of gold per annum. In the New Modderfontein the dip of the conglomerate lode is 20° and the stoping width is 42 inches; in the Modderfontein B the dip is 10° and the stoping width 48 inches. This extremely low dip will increase the cost of extraction and will necessitate the adoption of special methods of exploitation. In our December issue we gave a précis of the description of the long-wall method to be applied, as planned by H. S. Martin, an English colliery engineer recently engaged to advise on the betterment of underground methods. Mr. W. W. Mein's report is to be published at an early date.

RHODESIA. — The share market has been sobered by statistics showing that the Chartered Company's country produced £2,623,788 in gold during 1909, as compared to £2,526,007 in 1908. The increase is small, and is due mainly to two of the larger mines. But general conditions are excellent and a decided improvement is anticipated, as indicated in the interesting article by Mr. A. H. Ackermann appearing on another page. In the region tributary to Bulawayo the several exploration companies are in hopeful mood, for the development of agriculture is giving a value to their land, and the 'small workers' or tributers are paying royalties while at the same time testing the mineral areas. Rhodesia needs population, which is coming as the railways are built and the country opened to settlement. The mining industry is progressing, but we hope that the mine end of it will be kept above the share-market end. Reckless gambling has been a feature of the Rhodesian department. Thus Globe & Phœnix were lifted to 7¾ just before the semi-annual estimate of ore reserves was published, indicating a handsome increase, from 168,933 tons of 22 dwt. ore to 171,507 tons of 31 dwt. ore. Yet even the latest estimate means only £1,124,878 gross as against £1,550,000, the present market-valuation of the mine. Allowing for a profit of 75%, it is apparent that the ore assured represents only 55% of the market quotation. In a mine of this character such a proportion is inadequate as the basis for reasonable speculation. Therefore it may be presumed that all the favourable factors are not generally known and that well informed persons believe the Globe & Phœnix to be "another Golden Horseshoe." Assuredly, an orebody that has proved persistent to 1600 or 1700 ft. does credit to Rhodesia. Giant shares are weak on the lack of news from the mine since the so-called 'reef' was cut on the seventh level. The cryptic character of the telegrams may be due to the abnormal type of the deposit, and the consequent difficulty of finding suitable words in the telegraphic code-books? However, it is a cheerful fact that the new mill, doubling the crushing capacity, is about ready to start. Another episode enlivened the market early in February, when a spectacular lift in the shares of the Surprise was caused by the receipt of a cablegram from Bulawayo announcing the finding of a rich vein. The incident is also remarkable as an instance in which the shareholders got the good news before it reached outside operators, two of whom received cablegrams a few hours after the company had published the information. Our compliments to the directors.

WEST AFRICA.—One of the notable episodes of the past month was the flotation of the West African Mines with a capital of 100,000 ordinary and 200 founders' shares of £1 each. This is a corporation formed to acquire interests in West Africa; it is an 'exploring' and 'investment' company, starting with no property but rich in the goodwill derivable from the support of several financial groups. Without a stroke of business and without even the promise of any definite plans, the shares have been run up to £5½, so that a premium of 450 per cent has been created out of a financial vacuum. This sort of wild gambling is not going to help the mining industry of the Gold Coast; it subordinates speculation to actual work; it suggests that the pockets of the public are more productive than holes in the ground.

The output of gold from West Africa in 1909 was 235,972 oz., worth £955,635, as against 297,366 oz., worth £1,186,342 in 1908 and 293,218 oz., worth £1,154,885 in 1907. These statistics furnish a good example of the inability of bald figures to give a correct interpretation of facts and conditions. It must be remembered that some of the leading mines, notably Wassau, Abbontiakoon, and Prestea have entirely ceased production; work is being concentrated on development, pending the completion of the Prestea - Tarkwa railway, this policy having been recommended by the advisors of several important firms that have recently subscribed large sums of capital for the development of the mines and the erection of mills. Thus there has been a curtailment of output since June.

AUSTRALIA.—The coal strike has hurt the Broken Hill mines, as well as others dependent upon a supply of fuel from the Newcastle mines. Our Melbourne correspondent describes the latest phases of this industrial conflict. Meanwhile the promoters of the strike have been punished; the chief receiving a sentence of 12 months' hard labour, and his assistants lesser sentences, but enough to assert the rights of the community against industrial piracy. The exemplary punishments imposed by the Australian court ought to prove salutary to labour-unionism in other countries as emphasizing the illegality of a conspiracy to paralyse the trade of an entire people in order to win a strike. We hope that the same measure may be meted to employers who use the lock - out in a similar way, regardless of the welfare of the community.

The success of the boring for artesian water at Madura, 340 miles east of Kalgoorlie, on the new railway line, is as important to mining as to agriculture in Western Australia. We hope it will be fully confirmed. According to the latest advice the mills and tailing-plant of the Broken Hill Proprietary were closed for lack of coal on February 6, but the smelter at Port Pirie continues in operation. Owing to the slight margin of profit this company does not lose much by cessation of operations at Broken Hill. On the other hand the Zinc Corporation, the Sulphide Corporation, the South Blocks, and the Broken Hill North companies are paying £3 to £4 per ton for coal delivered, in the expectation that the strike will not last much longer.

It appears that the famous mining district of Bendigo, in Victoria, is doing well, the output for 1909 being 212,034 oz., yielding £159,865 in dividends, as compared to 193,253 oz. gold and £126,268 in dividends for 1908. Twenty mines paid dividends, led by the Virginia with £40,500. Ninety mines failed to distribute any profit. The best returns came from comparatively shallow ground.

CANADA.—In British Columbia the mineral output for 1909 was slightly larger in value than in 1908, the total being $24,426,500 as against $23,851,277. The detailed figures for 1909 are given by the *Canadian Mining Journal*:

Gold	280,000 oz.	$5,767,500
Silver...............	3,000,000 oz.	1,470,000
Lead...............	46,000,000 lb.	1,748,000
Copper............	41,000,000 lb.	5,289,000
Zinc	10,000,000 lb.	500,000
Coal and coke....	2,217,000 tons	8,452,000

The decrease in the yield of gold is due mainly to the smaller production of the Le Roi mine, at Rossland.

Our Toronto correspondent refers to the rush to the Porcupine district in Ontario. This 'snow stampede' is like others that have attracted energetic adventurers into this mineral region, and it remains to be seen whether it will lead to the development of a new mining district. Some of the ore has been sent to London; it presents an attractive appearance, showing free gold, associated with iron pyrite, in a ribboned quartz.

MEXICO.—The rise in Mexico Mines of El Oro has provoked comment. It is due to purchases from Paris. About two years ago Mr. J. G. Fournier induced French speculators to buy shares in the Dos Estrellas mine, which is in the El Oro district. These shares were taken at 240 francs and are now quoted at 840 francs, equivalent to a price of over £10,000,000 for the Dos Estrellas mine. Subsequently shares in the Nolan property were placed in Paris, and, although this mine is not productive as yet, the shares have risen lately to 4700 francs, giving the property a valuation of £1,200,000. This is more than the figure at which the Mexico mine was valued on the market. Thus the attention of French speculators was drawn to neighbouring mines, with the result that shares in the El Oro and in the Mexico mines proved attractive at Paris and options were freely bought on blocks of shares. Hence the rise, which has in no sense been 'engineered' by the Exploration Co. However, the actual mining news is also satisfactory. In the Mexico, the development of the West vein on the 7th level continues to disclose rich ore. This vein was cut by a crosscut near the Esperanza boundary in August and has been followed by a drift for 175 ft., of which the last 75 ft. has been in stuff assaying 4 to 5 oz. gold and from 40 to 100 oz. silver for a width of 5 to 5½ ft. The whole length of the drift is in pay-ore. At the El Oro mine the new ventilation shaft on the Somera claim has been connected with the 1000 ft. level, thus completing a project of vital importance to the exploration of the deep ground. This three-compartment shaft has been equipped and sunk 1536 ft. in less than a year, a feat that is highly creditable to the local management. It will be remembered that the veins at El Oro are capped by lava, so that the uppermost stopes do not penetrate to daylight and the managers have been chary of piercing the cap for fear of admitting surface drainage; hence the ventilation has suffered until now. As regards the La Reforma, we are informed that the option taken by the Exploration Company of England & Mexico expired on December 31, and nothing further is being done.

ALASKA is famous for its gold-bearing alluvium but the interior of that region has not as yet been the scene of much lode-mining. The Treadwell group of mines is on Douglas island and on the mainland opposite other large lodes are successfully exploited, but the vast hinterland to the north beyond the coast range has been explored for several years in a futile search for gold-bearing quartz veins. Now we learn from a correspondent at Dawson that the Lone Star mine, until recently involved in litigation, has yielded 100 tons of ore that yielded $1334 in gold. One swallow does not make a summer, and a 100-ton lot of ore does not make a profitable mine, but the event is important as indicating the beginning of successful lode-mining in the Yukon Territory. If gold-quartz veins are found in the Yukon, they ought to be found in Alaska, for these two regions are separated only by an imaginary line having no geological significance. Meanwhile the reports of dredging operations in the Klondike valley indicate that the past season was most satisfactory and that the cost has been reduced to 15 cents per cubic yard.

COPPER.—It is announced that J. P. Morgan & Co. have no plans under consideration for any copper combine. This is accepted as a polite bow to authority at Washington, and a recognition of the fact that the time is not opportune to provoke enquiry into combinations "in restraint of trade." Meanwhile minor, but big, consolidations are being effected, thereby preparing the way for a comprehensive amalgamation of interests in the future. It is considered by the leaders of strategic finance in America that it is more convenient to segregate the various copper-producing companies into two or three groups, so that half a dozen men can meet at a round table and decide upon a definite policy than to attempt concerted action with a large number of producers of unequal weight and diverse affiliations. Moreover, while consolidation enhances the value of shares as collateral, itself a beneficent result, it simplifies those banking arrangements necessary to colossal stock-exchange operations out of which, rather than industry, the big fortunes have been won in the United States. During January the merger of the Boston Consolidated, Utah Copper, and Nevada Consolidated companies has been effected, despite the protest of minority shareholders. The advantage of consolidating the two mines in Utah was obvious ; they are adjacent ; their operations tended to encroach upon and to hinder each other ; they produced the same kind of ore and they could be worked more cheaply under one management than under two conflicting controls. If the first proposals were opposed, it was because the basis did not conform to the estimated value of the two properties : at first the idea was to consolidate on a parity, but eventually 1 share of Utah was rated as equal to 2½ shares of Boston ; and this, as far as we can learn, was a just appraisal. Next the Guggenheims, through their agent Mr. Samuel Untermyer, proceeded to force the amalgamation with the Nevada Consolidated, against the wishes of large holders of shares in both the Nevada and the Utah Copper companies. The great mine at Ely has developed 29 million tons on which a profit of $2 per ton is estimated, but the Utah mine is credited with 70 million tons on which a profit of $1 per ton is calculated. Even the best engineers found difficulty in making a relative valuation. While the Utah mine has been delivering copper at 8 cents per lb. at New York from ore averaging 1·6% copper, the average tenour is claimed to be 1·85%, the lower return being due to exceptional conditions caused by caving of the overburden. While the Nevada mine is producing copper at 6½ cents per lb. at the rate of 70 million pounds per annum, the yield is 2·4%, but it is claimed that this is due to an excess of ore from near the surface, the average being 2·05%. The basis of consolidation is 2¼ shares of Nevada Consolidated for 1 share of Utah. Against this arrangement James Phillips, W. Hinckle Smith, and C. Hartmann Kuhn have protested strongly, but in vain. The copper mines controlled by the Guggenheims, Untermyer, and their friends are thus being consolidated on the one hand, while the Standard Oil group in Montana is concurrently being unified, the latest move being the merging of the Boston-Montana subsidiaries with the Anaconda, accompanied by an increase of capital equal to $30,000,000. The prospects of Arizona Copper, a Scotch company, receiving a handsome premium by the sale of its shares to the American merger-mongers have been nipped in the bud ; but they may blossom later, when conditions improve. At present all American copper shares are much depressed by general financial and political conditions.

EDITORIAL

UNDER the heading of 'Discussion' we publish interesting letters from Messrs. John S. MacArthur, E. T. McCarthy, Frank Merricks, Alexander Hill, and C. W. Purington, besides a valuable and lengthy communication from a writer who disguises his vivid personality under a *nom de guerre*. To these gentlemen we tender hearty thanks for their co-operation in making this Magazine useful in the collecting of facts and the crystallizing of opinion.

LABOUR troubles are crippling mining operations in Australia, and in America the great Homestake mine has been shut-down for two months in consequence of a strike followed by a lock-out. First the labour-union refused to work if non-union men were employed by the management, and then the management refused to employ any but non-union men. Thus two wrongs were done and fair dealing as between man and man was flouted. The refusal to work with non-union men is as unreasonable, tyrannical, and anti-social as is the refusal to employ members of the union. Assuredly the rights of working men and the protection of capital will gain nothing by such obtuse disregard of social justice.

IN THIS ISSUE we publish a letter on dredging for gold, written frankly from the American point of view. While we are glad to give space to one so well informed on the subject as Mr. Purington, we shall be equally pleased to publish testimony in regard to the good work done by dredges of European or British manufacture. Among our readers must be several mining engineers who have successfully applied dredges of British design; we appeal to them to contribute information so valuable at this time, when the application of dredges to gold-bearing alluvium in Siberia, West Africa, Colombia, Burma, French Guinea, and Alaska suggests how widely this branch of mining has been extended.

FROM JOHANNESBURG we learn that systematic milling tests of great interest are being made by Mr F. L. Bosqui, in behalf of H. Eckstein & Co. Twenty stamps, a tube-mill, the requisite classifiers, and amalgamation plates have been set aside at the Jumpers Deep mill for this purpose. A small zinc-dust precipitate-press, with a capacity of 60 tons of solution per day, is on its way to supplement this trial plant. It is hoped within six months to ascertain (1) the economic limit to fine grinding in tube-mills, (2) how much of the *minus* 150 sand now treated by percolation can be treated advantageously—while in mixture with the slime — by agitation, followed by vacuum-filtration, (3) whether Brown agitators and vacuum-filtration are preferable to decantation, (4) how the work of comminuting the ore should be apportioned between stamps and tube-mills, and (5) whether zinc-dust is better than zinc-shaving as a precipitant. We may add that a 500-ton Butters plant is being installed at the Crown Reef, and should be ready in June. Thus several points affecting the development of local metallurgical practice will be decided at an early date.

AN INCREASE of $359,000,000 in the imports of the United States during 1909 affords eloquent testimony to the recovery of American industry, but other statistics suggest that the revival is being minimized by other less favourable factors. "The steady relentless increase in the price of everything that goes to make up the cost of living" tends cruelly to diminish the benefit derived from bountiful harvests, prolific herds, and generous mines. Wages have risen, and must rise further, because the necessaries of life are becoming continually more expensive; the consumption of natural products is gaining upon production; in fact, the great nation on the other side of the Atlantic exhibits signs of domestic extravagance such as will prove ruinous to its welfare, if not to its commercial stability. As Mr. James J. Hill has said recently, it is not so much "the high cost of living as the cost of high living." And that involves an inveterate discounting of the future, the gambling in every product of industry, and existence under abnormal pressure. Thus we note that during the year lately ended the quotations of 18 railroad and industrial shares have appreciated to such an extent as to represent an advance of $638,000,000 in the aggregate market valuation. Allowing for better conditions, and allowing for a further improvement, it is still apparent that the general public has been drawn freely into a veritable orgy of speculation.

MR. ROOSEVELT'S glimpses into the Miocene and his spirited portraiture of frontier life in the highlands of East Africa are likely to incite others to visit that portion of the once Dark Continent. Dark it no longer is, thanks to explorers, hunters, miners; on the contrary, every year sees additional tracts of country opened to settlement, cultivation, and civilization. The ex-President's descriptions of his hunting experiences emphasize the fact that the sport of killing big game has itself been killed by improved firearms; when men attacked the big beasts with weapons that allowed one, or at most two, shots without re-loading, and when the range of the rifle was limited, the contest between man and the wild animals was a duel, in which the odds were not all on one side. Now it is a scientific butchery, and it is only necessary to travel far in order to shoot big game like cows and to attack even the most ferocious with assured confidence of immunity from danger. Mr. Roosevelt's vivid accounts of the region in which he has been hunting are worth more than his trophies, for he has made known Nairobi as a region for white settlers.

FROM CORNWALL the latest news is that the waters of the Trenwith mine have been found radio-active and that the St. Ives Consolidated, which owns this interesting property, is about to utilize the possibly curative powers of the water by erecting a hydropathic establishment such as will make the Cornish Riviera the rival of Marienbad, Carlsbad, and other famous localities to which the richer portion of humanity flocks at such times as a restorative is urgently required. To those possessing imagination no comment is needed; to those devoid of imagination the waters of the Trenwith mine may prove a stimulant. We are reminded of a mine in Calaveras county, California, that yielded water containing gold chloride in solution, and the fact was not discovered until all the miners developed a dislike for whisky and other spirituous liquors not infrequently imbibed by those hard-working delvers below-ground. It was a natural Keeley cure. The men refused to work under conditions so depressing and went to other mines where a reasonable taste was not atrophied by abnormal circumstances.

OUR CONTEMPORARY at Chicago, *The Mining World*, published an article on January 15 describing the Dolcoath mine. The accompanying geological description of Cornwall caused us at first to rub our eyes, and then to formulate this expression of sympathy with a contemporary that has been the victim of a scientific imposture. The article begins with the statement that "the southwest extremity of England consists of a great expanse of old red sandstone extending from sea to sea. Rising out of the sandstone are extensive areas of granite. The whole district is intersected by dikes of basalt running east and west and curiously parallel. The mineral deposits occur mainly in the north in the area surrounding the town of Camborne. At Dolcoath the lodes occur mainly in granite, which comes to the surface in this locality, and in places dips down with an undulating rolling surface which is now concealed under rock formations locally known as killas, a slaty deposit of ancient mud accumulated under water on the weathered granite." This quotation will suffice. Such a grotesque description cannot have been perpetrated by anyone but a practical joker, and a joker deserving of condign punishment, for he has imposed upon the credulity of the innocent readers of a journal supposedly devoted to the dissemination of technical information. We are reminded of the French academician's definition of a crab: "A red fish that walks backwards." When this was shown to an eminent naturalist he observed that a crab was not red, was not a fish, and did not walk backwards, otherwise the definition was good.

DURING the past month we have received formal announcement of the fact that two mining engineers, veterans in experience, though still actively engaged in professional work, have taken their sons into partnership. Mr. John B. Farish is to be assisted by Mr. George E. Farish, while Mr. Philip Argall is joined by two of his sons, Philip Henry and George Oates. We proffer our hearty congratulations on an event both interesting and auspicious. It is pleasant to see the continuity of the mining tradition so well preserved and to receive assurance that an honourable name will be carried forward by the younger generation. And in this case we venture to mention the fact that the sons have had a better technical preparation than their fathers, for all three of the young engineers mentioned are graduates of well known colleges. But we do not say that they start their careers as consultants with a better education than their fathers, for 'education' is a broader thing than 'instruction,' and we have reason to know that in this case the fathers managed to get a pretty good preparation for a useful career without the accolade of a university. But it does augur well for the future of the profession that men themselves without an academic seal should have given their sons the fullest advantage of the modern school of mines. It remains for the sons to 'make good'; we believe they will, and we wish them every success.

THE number of companies registered at Somerset House is 46,471, with a paid capital of £2,163,132,780. These are only the corporations actually in existence, for the number of public companies registered since 1862 is over 100,000. According to Mr. Edward Mauson, the feature of recent registrations has been the increase in companies of small capital. These are mainly 'private' companies, that is, partnerships organized as corporations in order to obtain the protection of limited liability, the right to borrow money on debentures, and perpetuity in the face of the mortality of individuals. By the new Companies Act of 1908 the private company obtained statutory recognition; it must consist of not more than 50 persons, it must restrict the transfer of its shares, and it must not appeal to the public for capital. On the other hand, two persons suffice to form a 'private' company; it can engage in business at once, upon incorporation, without a certificate, and it is not required to file an elaborate report previous to the statutory meeting. Finally, no obligation exists to present a balance-sheet, and exemption is granted from furnishing such information to preferred shareholders or debenture-holders. Thus privacy is accorded to the private company and most of the advantages of partnership are secured without disadvantages.

Mining in Sonora.

Sonora is one of the States of Mexico adjacent to the American border and covers a large territory in which are several celebrated mining districts. It is amusing therefore to read that "when the Hudson's Consolidated first took an interest in the Barranca mines, Sonora was practically an unknown country." This was stated at a recent public meeting, together with sundry harmless platitudes concerning the Guggenheims and Harriman. To those who are familiar with Sonora as one of the great mineral regions of the world, it will be no news that several important groups of mines in that State have been operated for more than a century. We may mention the Trinidad and the Mulatos. General Pesqueira was working the Santa Helena at Las Delicias fully fifty years ago, and thirty years ago Covington Johnson was in charge of the Minas Prietas, then being exploited by Clarence King. Twenty years ago John Williams smelted copper ore at San Antonio, on the Yaqui river, and even earlier, in 1880, Pesqueira was smelting lead ore at Cananea. It was then that Riley induced James Douglas to investigate copper deposits that he thought as promising as those of Bisbee, on the northern side of the international boundary. At Nacozari, operations were begun more than fifty years ago at the Fronterras mine, which is still active. Weir opened up the Pilares in 1883 and operated this group of mines until the Guggenheims acquired them, selling them in turn to Phelps, Dodge & Co. in 1897. The Barranca, concerning which the daily Press has furnished numerous reading notices, is near San Xavier, one of the oldest mining settlements in Sonora. The mines are reputed to have been worked fully 200 years ago, by the Jesuits. At the neighbouring hamlet of San Antonio de la Huerta, another old Jesuit settlement records the mining operations of the padres. Here is the San Antonio copper mine, recently acquired by the Cole-Ryan syndicate. Owing to raids from the Yaqui Indians this region has not progressed until lately, but now the Cananea, Rio Yaqui & Pacific railroad will pass through Toledo, which has a custom smelter and is a distributing point for these old districts.

East Siberia.

It is gratifying to learn that the Russian Minister of Commerce, acting under the direction of the Minister of the Interior, has waived the prohibition against mining operations on the part of a foreign company on the littoral of the Okotsk Sea. Our readers are probably aware that a regulation framed by the Department of Mines prohibits any foreigner from engaging in mining, either as proprietor or employee, anywhere within 100 versts, or 60 miles, of the Siberian shore. During the past summer the Orsk Goldfields, an English company, has been engaged in prospecting and exploiting gold-bearing alluvium in the Primorsk district, near Nikolaievsk, within 50 miles of the mouth of the Amur. These operations have been so successful as to warrant work on a larger scale; but before involving themselves in further expenditures for plant and machinery, including the erection of a modern dredge, it became necessary to obtain special permission, from the Minister at St. Petersburg, with the assent of the Governor General of Eastern Siberia, to employ foreigners and to work within the prescribed limit. This is the more anomalous as the Chinese have a legal right to mine in this very tract by virtue of a treaty made at the time the territory was ceded by China to Russia. After negotiations protracted in a needlessly aggravating manner for nearly two years the Orsk Goldfields has at last been allowed for three years to employ 20 foreigners and to work within the boundaries of the property now held under a long lease. Before the three years elapse, it is altogether probable that a further extension will be granted, for by that time the importance of the enterprise, and its useful bearing upon the industrial development of the region, will be better understood.

This incident draws attention to the broader question of Anglo-American enterprise in Eastern Siberia. Only recently the American Secretary of State, Mr. P. C. Knox, made the proposal to neutralize the Manchurian railway system and thus in effect establish an international zone immune from the clash between Russian, Chinese, and Japanese authorities. It is also proposed to build a railway extension from Tsitsicar, which is on the Chinese Eastern, itself a part of the Trans-Siberian railway system, to Aigun, on the Amur, at a point nearly opposite the city of Blagoveshensk. This is likely to prove an important undertaking because Blagoveshensk is the distributing point for an extensive alluvial mining region covering the watersheds of the Zeya, Burea, and Selenja rivers, down to their sources in the hills overlooking the sea of Okotsk. It is believed by mining engineers who have investigated the detrital deposits of this wide region that they present excellent opportunities for profitable exploitation on a large scale, but at present any foreign enterprise is crippled by restrictions such as those that the Orsk Goldfields had to face. The Russian objection to a peaceful industrial invasion of Eastern Siberia is due possibly to the fear of an exposure of their administrative weakness in this enormous range of country. Taking the broad band along the coast covered by the 100 versts or 60 mile limit, it is safe to say that the Russian population comprises not more than 30,000 settlers in a length of 6000 miles, from Korea to the mouth of the Anadir river. The same exclusion of foreign industry applies within 100 miles of the Chinese border from Irkutsk eastward, involving a length of 2000 miles. By these prohibitions Eastern Siberia is closed to effective development. If the Russians were willing and able to undertake the work themselves, such protective restrictions might be deemed not unreasonable, as based upon a patriotic purpose, but they are doing nothing themselves beyond sending a few subsidized peasants to engage in rudimentary agriculture, and there appear to be no signs of any desire on the part of Russian capitalists or engineers to undertake the exploitation of a region big enough for both domestic and foreign mining operations.

American Mining-Land Laws.

Political sentiment in America is deeply stirred by the Pinchot-Ballinger controversy, and the results likely to follow from the President's abrupt dismissal from the public service of Mr. Gifford Pinchot, the intimate friend of Mr. Roosevelt and, in popular estimation, the foremost advocate of the Roosevelt policy, particularly as related to the conservation of natural resources. The quarrel arose over Alaskan coal lands. Mr. Pinchot has been foremost among those who believe that certain claims were obtained by fraud, and it has been openly and repeatedly charged that Mr. R. A. Ballinger has been actuated, as Secretary of the Interior, by improper motives in ordering these claims pressed to patent as well as in appearing before the Department as attorney for the claimants in the interval between his term of service as Commissioner of the Land Office and his appointment as Secretary of the Interior. Mr. Taft, as President, after examining the papers submitted by Mr. Ballinger and Mr. Glavis, the inspector who brought the charges, ordered the latter to be discharged and issued a statement exonerating and even eulogizing his Secretary. This statement, unfortunately, has not been taken at its face value by the American people, and it is fair to say that Mr. Ballinger does not possess the general public confidence. The probable reason for refusing to accept Mr. Taft's word as final in the matter, lies in his action in connection with the tariff. After promising not only strongly but repeatedly, to insist upon a revision downward, he not only signed, but has defended in numerous speeches, a tariff bill that is generally believed to be essentially dishonest, a bill framed in the interest of the few rather than the many, and one that has seemingly raised rather than lowered the cost of living. Feeling finally rose to such a height that an elaborate investigation of the acts of the Secretary of the Interior and of the Forest Service was ordered. At this moment Mr. Pinchot not only refused to dismiss certain assistants who admitted having made public some of the facts upon which were founded the charges against Mr. Ballinger, but came out also in a ringing address appealing to the higher patriotism that serves a people rather than an administration. He was promptly dismissed by the President for insubordination, but this technical fault is likely to be forgotten in general approval of his attitude. Mr. Pinchot is one of the young and wealthy men in the public service who were brought forward and became active under the spell of Mr. Roosevelt's example. He is admittedly capable and disinterested, and has handled the extremely difficult problems incident to the rapid development of the Forest Service, with signal ability. Mining men have complained bitterly and often justly against certain regulations of the Service, but Mr. Pinchot personally undoubtedly has the general public confidence, and is looked upon by many as the special representative of Theodore Roosevelt, who remains now, as he has long been, the most generally trusted man in the United States. It is evident that in dismissing Mr. Pinchot, Mr. Taft has precipitated a bitter fight, and one that he had previously striven hard to avoid. All this is mainly significant to those engaged in mining because the result is likely to determine the attitude of the Government toward mineral lands and mines, for many years to come.

Dry Chlorine.

We have published two letters, one in this issue and another in January, written by Mr. E. A. Ashcroft and Mr. John L. Malm, both deprecating observations appearing in our December issue in regard to the Malm dry chlorine process. Our remarks did not constitute a detailed criticism, but were confined to the statement that the Malm process now being introduced in Colorado is similar to that tried and abandoned by Messrs. Swinburne and Ashcroft in England several years ago; and we expressed the view that owing to the difficulty of working the reaction based upon the displacement of sulphur by chlorine, and owing also to the costly nature of the electrolysis of zinc chloride, we were not greatly impressed with the prospects of a practical application of the process in Colorado. Naturally our remarks did not please those interested in the business, and in fairness to them we have inserted as much of their letters as was to the point. Our comment and their replies suffer from being far shorter than the nature of the technology of the process demands. The subject is a complicated one, and the success of the process depends on a number of factors; and when writing in December we assumed that the majority of our readers would not be interested in a minute discussion of details, but that those who had a special interest in the subject would already have seen the many detailed accounts of Mr. Malm's experiments, published in the *Mining and Scientific Press* and other technical journals.

We agree with both writers that the cheaper current available nowadays is a point in their favour when considering the cost of the electrolysis of fused zinc chloride, but this does not alter the fact that compared with other electrolytic and chemical reactions, the electrolysis of fused zinc chloride is expensive. Even with the greatest economy in generation the cost will be high owing to the amount of current used. This is not the only consideration, for the expense of constructing and maintaining a plant where chlorine is evolved is also a serious item. Then our correspondents object to the remark that the reaction of substituting sulphur by chlorine is difficult in practice. They say, and quite truly, that the reaction is not only easy to work but also rapid and even boisterous. This, however, is an interpretation narrower than we intended to convey. Perhaps if we had said that it was a difficult, expensive, and unpleasant process we should have been more explicit. The regulation of the reaction requires skilled supervision. The chlorine is an expensive element to produce, and is dangerous and destructive; besides, a large proportion of it is lost in the production of irrecoverable intermediate products. The gangue and the constituents of the ore other than the valuable metals cause serious trouble. It is difficult to remove them, and they cause losses of chlorine. The formation of compounds of sulphur and chlorine is also a disadvantage.

This process might be quoted as illustrating the economics of chemical reactions. Without entering into technicalities, we may say that from general principles the use of a reaction involving the substitution of an element having greater affinity for the metal, and the subsequent application of a strong electric current to dissociate the new compound in default of any possible chemical reaction, is obviously a bad policy. If the products are of decided market value, such a method is permissible, but in the present case, where the ores are low-grade and the recovered metals not of high value, the applicability of the process is open to doubt. It must be remembered that the dissociation of chlorine compounds electrolytically, even under the most favourable circumstances, is expensive. Even in such a simple case as the electrolysis of salt into soda and chlorine the difficulties are great. The Castner-Kellner process after a long struggle in producing soda, eventually reached a paying basis by making metallic sodium, which was subsequently used in making cyanide. The Hargreaves-Bird process has similarly had a fight for existence, though the soda and bleach are both of excellent quality. The power required to dissociate the elements, though produced in the most up-to-date manner possible, brings the cost to a figure too high to enable the products to compete with those produced by a chemical reaction such as the ammonia-soda process. In the latter process only carbonic acid is used for dissociating, and calcined limestone for recovering the ammonia. It is also notable that this process was only successful when the loss of ammonia was entirely eliminated, and by analogy, a chlorine process cannot be successful unless the losses are reduced.

This is a mere outline of the problem, and we have touched only a few of the main points. If Mr. Malm can save his chlorine, or produce it cheaply, devise plant that is not attacked by chlorine and can be worked without highly trained labour, get rid of gangue and other inconvenient constituents of the low-grade complex ore, and also obtain cheap current, he will be able to make the process a success. We hope for his own sake and for the sake of mining industry generally that he will be able to do so.

The Guggenheims.

At a time when the important part played by the Guggenheim family in the development of the copper industry is the subject of frequent conversation and criticism, it will be proper to review the history of this episode in American mining. The founder of the firm of M. Guggenheim's Sons was Meyer Guggenheim, an immigrant who came to Philadelphia about 56 years ago; he was a poor man, and started as a petty trader, but being shrewd and extremely acquisitive of every kind of information, he prospered. He became a lace merchant and had large contracts with factories in Switzerland. Among his friends was A. J. Graham, a Philadelphia publisher, who loaned money to Harsh and Carey, the owners of the A.Y. and Minnie Mine at Leadville, Colorado. Graham borrowed $5000 from Meyer Guggenheim. The owners of the mine got into trouble and thus the A.Y. and Minnie passed into the possession of Graham and Guggenheim, the latter having a half-interest. This mining enterprise proved profitable, for the silver-lead ore commanded a good price at the smelters and the output of the mine then did not consist of the low-grade zinc ore for which it later became so well-known. Benjamin Guggenheim, one of Meyer's sons, came from Philadelphia as a clerk in the mine at Leadville. During a visit to Colorado the intelligent curiosity of Meyer Guggenheim was attracted by the heavy charges levied by the smelters, and he made detailed enquiries into the business of smelting; it looked like the best end of the game. Later, Ben Guggenheim went to the Globe smelter, at Denver, where he served as timekeeper. There he met Edward H. Holden, a promoter of smelting companies and an enterprising citizen. Holden got Ben Guggenheim interested in the project to build a smelter at Pueblo, and persuaded him to broach the subject to his father, Meyer Guggenheim. This was done. Holden and Chanute discussed the matter with the elder Guggenheim, and shortly afterwards Holden, having differences with C. B. Kountze and Dennis Sheedy, the bankers who controlled the Globe or Holden plant, went to Pueblo, where, with Ben Guggenheim, he established the Philadelphia smelter, the A.Y. and Minnie mine being the basis of their ore supply. The Philadelphia plant was built in 1886. At this time and for this purpose Meyer Guggenheim organized a corporation known as M. Guggenheim's Sons, each of the seven sons obtaining an equal share in the smelting enterprise. But the operations of the Philadelphia plant were conducted at a loss for several years and it was only after many changes that the smelting company secured men able to conduct the business successfully. The first to turn the scale was Mr. August Raht. When this satisfactory result was reached, the Guggenheims branched out, building a smelter at Aguascalientes in Mexico and later another at Monterrey. In 1899 a consolidation of smelters was formed under the corporate name of the American Smelting & Refining Company; the nucleus of this combination was the United Smelting and Refining Co. which owned smelters at East Helena and Great Falls and the National Smelting & Refining Co.'s refinery at Chicago. These smelters controlled the supply of lead ores from the Cœur d'Alene and held a strategical position of great importance. Another important member of the consolidation was the Omaha & Grant Smelting & Refining Co., with smelters at Denver, Leadville, and Omaha; to these were added the plants of the Kansas City Smelting & Refining Company, the Pueblo Smelting & Refining Company, the Colorado Smelting Co. at Pueblo, the Durango smelter, and the Germania at Salt Lake City. The Guggenheims were not in this combination. For a while active competition existed between them and the Trust, as it soon became labelled. A clearing-house for ore at Denver prepared the way for a merger. The Philadelphia smelter, the Perth Amboy lead and copper refinery, and the Mexican plants of the Guggenheims were absorbed by the American Smelting & Refining Co. in 1901. For their property the Guggenheims received $17,500,000 preferred and $17,500,000 common stock at par. The capital of the American Smelting & Refining Co. having been increased from $54,800,000 to $100,000,000, thereupon $10,200,000 preferred and common in equal parts were sold outside to obtain more working capital. At this time Daniel Guggenheim, the eldest son, was made chairman of the executive committee, and on the death of E. W. Nash, in 1905, he was appointed President of the organization. In the interval the Guggenheims had bought blocks of the common stock and with the shares held by friends they thereby acquired the dominance, which they have held until recently. In 1905 the American Smelters' Securities Co., a subsidiary company, which was then formed, purchased the Selby, Tacoma, and Everett smelters, thereby emphasizing the hold of the Guggenheims upon the metal and ore markets of America and Mexico, although they enjoyed at no time a monopoly, or anything near it, in copper or lead smelting.

During the last four years the Guggenheims have enlarged the scope of their activities and under the leadership of the eldest of the brothers, Mr. Daniel Guggenheim, an exceptionally able man, they have acquired interests in mines and smelters in many regions.

Concurrently with this expansion they have speculated on Wall Street and have become involved in several risky transactions, which have accentuated the fact that their success as business men in control of such an intricate industry as smelting has not qualified them to play the part of financiers. The Nipissing affair, the Yukon fiasco, and the Nevada Consolidated manipulation have not conduced to their reputation, indeed these episodes have detracted from their honourable standing. There is reason to believe that they lost most of their holding of American Smelting during the panic of 1907 and in the subsequent re-adjustment; they recouped themselves in part by the success of the Nevada Consolidated and Ray copper mines; but the Wall Street game has proved too much for them. It is an old story: the baritone wants to sing tenor, and the business man yearns to be a financier. This human frailty has proved the undoing of the Guggenheims, and has finally landed them in the capacious net of the 'big interests,' dominated just now by Mr. J. P. Morgan, whose leviathan banking combination appears destined to swallow most of the fish that have escaped the net of the Standard Oil and still disport themselves in the troublous waters that surge round the southern end of Manhattan Island.

Functions of the Engineer.

On another page we publish a letter from Mr. E. T. McCarthy in which he refers to the position of a consulting mining engineer in relation to the board of directors by whom he is employed. Mr. McCarthy expresses the view generally held in London that the engineer should have a seat on the board, so as to be able to take part in the deliberations of the directors and be enabled to place on official record the differences of opinion, if any, that may develop. This is supposed, of course, to safeguard his hold upon the confidence of the shareholders, for whom the directors act as trustees. It is not intended that the engineer should dominate the board, nor is it considered advisable that he should qualify by becoming a shareholder. Obviously, the expectation is that the engineer will be in closer touch with headquarters and be permitted a larger say in formulating the policy for which he is likely to be held responsible. In corroboration of the views expressed, for himself and others, by Mr. McCarthy, we may mention the fact that in the United States the consulting engineer may be not only a director but, in some instances, the president of the company. Thus Mr. J. Parke Channing was the president and consulting engineer of the Tennessee Copper Company when it was controlled by the Lewisohns, and Mr. F. W. Bradley is president and consulting engineer of the Bunker Hill & Sullivan Mining Company, which was controlled by the late D. O. Mills and is now dominated by his son, Mr. Ogden Mills. As far as we are aware this arrangement of putting the pilot in command of the ship should answer well, enabling the vessel of industry to be navigated safely through dangerous shoals, even amid watered stock and barren reefs.

The purpose is to place the responsibility where it belongs, and accord either blame or credit to the man on whose advice the technical operations of mining are performed. It often happens that the lack of executive authority places an engineer in an impossible position and lands the company's affairs in a fiasco that might have been avoided by simplifying the organization so that the figure-heads are restricted to their relatively ornamental functions. The titled chairman ignorant of mining and the busy merchant too occupied to pay proper attention to details are unsafe exponents of policy as applied to a mine many thousand miles away. Better work, at less expense, can be effected by diminishing the decorative functions of the chairman unversed in technical affairs and by bringing the consulting engineer to the front, where he can face his clients, the shareholders. To return to our simile, imagine the absurdity of placing the chairman of a navigation company in command of a ship. In calm weather the danger of such a procedure might be slight, but when the storm arises the expert sailor would be called hastily from the smoking room while the figure-head would seek the seclusion of his cabin. It amounts to this: Discard the unrealities that hinder the successful exploitation of mineral deposits. Place the responsibility where it belongs, and then compensate adequately the man who accepts that responsibility. We have spoken on other occasions concerning the participation of mining engineers in share speculation and promotion, as being subversive of the unbiased judgment and undivided attention expected from a professional adviser. To this we now add the postulate: that the man who foregoes the chance to make money by speculating 'on the side' should be compensated for such deprivation. Is it not fair to suggest that the small salary paid to men saddled with large responsibility and burdened with heavy duties is a factor in prompting them to utilize other means of gaining a competency by the time they are old? Would it not be well for directors to be more liberal to those who give undivided service? Thus, let us suppose that the directors of a company are about to engage an engineer as general manager at a salary of £1000 per annum. The engineer is willing to abstain from market transactions, he is willing to do nothing else except the work of general management. Then, as compared to another man who will not deny himself the chances of the stock-market, he is entitled to more salary, and the directors ought to be glad to pay him £1500 or even £2000 per annum, as compared to the £1000 paid to a manager who is dabbling in his own company's shares or in those of other companies. As between two men of equal technical ability, the one who keeps aloof from the gambling connected with mining is worth more as manager and should be paid more. In our opinion the engineer who adopts this attitude will in most cases be more effective, happier, and richer in the end than the man who allows his interest to be scattered, financially and technically.

The Institute of Metals.

The formation of institutions and societies grows apace, and professional men are apt occasionally to bewail the consequent increase in the mass of literature through which they must wade in order not to miss important pronouncements. In consequence of expanding knowledge and deeper delving into details it is inevitable that special societies should be formed to study special subjects, and it often happens that the associations of limited range show great enthusiasm and prosperity. The Institute of Metals is one of these. When Mr. W. H. Johnson, a large user of copper and brass in Lancashire, first mooted the idea, about two years ago, of forming a society to discuss the technology of the metals and alloys with which his name is honourably associated, there was some scepticism as regards the necessity or even desirability of founding such an association. It was argued that the Institution of Mechanical Engineers fully met all the requirements of the users of the non-ferrous metals, and that the Institution of Mining and Metallurgy covered the ground of the producers. Many people also objected that the secrets of the metallic arts are so jealously guarded that the society would find few subjects for public discussion. Mr. Johnson, however, gradually overcame this passive resistance; he found ready recruits among the scientific investigators who had nothing to conceal, and he achieved a victory when he convinced the users of copper, brass, and allied metals and alloys, such as ship and engine builders, including the Admiralty, that knowledge relating to the constitution and behaviour of these metals could be best extracted and disseminated by such an institute. On mature consideration it became obvious that the metallurgy associated with mining ends at the production of the refined metal and that in comparatively few cases does this class of metallurgist trouble himself about the subsequent treatment of the metals or the ultimate effect in manufacture of the presence of various small admixtures of other metals. In many cases, of course, the final refining of copper has to be conducted in such a way as to satisfy the requirements of the particular customer, but these details are not of sufficient general interest to members of the Institution of Mining and Metallurgy to warrant much notice, though they are of immense importance to the user of the metal. It was felt also that although the Institution of Mechanical Engineers had rendered valuable services by researches in connection with alloys, the institution did not give the continuous attention to these subjects that was desired by the metal people. In consequence of these considerations, the amount of support fron influential quarters rapidly increased and in the summer of 1908 the Institute of Metals was formally inaugurated. The first general meeting was held at Birmingham in November under the presidency of Sir William White, late chief constructor to the Navy. In addition to the copper and brass people, those interested in aluminium, lead, zinc, nickel, and antimony gathered in strong force. The method of holding meetings is similar to that of the Iron and Steel Institute and the American Institute of Mining Engineers. Two meetings are to be held every year and each will last for two days. The time will be divided between the reading of papers, visits to works, and social functions. Following the Birmingham meeting, one was held early in 1909 in London and one in the autumn at Manchester. Another meeting was held in London last month under the presidency of Sir Gerard Muntz, whose name has been a household word for generations. In his presidential address he mentioned that the membership had steadily increased until now the number is 512. In looking back at the history of similar societies, the results obtained by the new institute, from the point of view of the extent and quality of the membership, is a matter of sincere congratulation. The quality of the papers submitted at all the meetings has been up to a high standard. The titles of some read at the January meeting indicate the scope: 'The Assay of Industrial Gold Alloys,' by Ernest A. Smith, of the Sheffield Assay Office; 'A contribution to the Study of Phosphor Bronze,' by O. F. Hudson and E. F. Law; 'The Analysis of Aluminium and its Alloys,' by R. Seligman and F. J. Willott; 'The Properties and Constitution of Copper-Arsenic Alloys,' by G. D. Bengough; 'Carbonaceous Filters in the Smelting of Zinc,' by C. O. Bannister. The discussions on the papers read are always illuminating and are contributed by men well versed in their subjects.

Sir Gerard Muntz, as an individual and also in his official capacity as president, has pleaded for the removal of the wall of secrecy, contending that the individual who puts original ideas before his fellows will reap perhaps so much benefit from the suggestions arising in the discussion that he will still be in front of his competitors although he may have told them something that they did not know before; he has, in fact, set the ball rolling for the collection and growth of ideas on his own special subject. Individual research and study are of course of primary value, but personal discussion with our fellows is a powerful instrument for the expanding and systematizing of ideas, and he is the ablest man who not only evolves ideas in his own brain but assimilates knowledge by freely discussing the subject with others. The Institute of Metals has done well by inducing discussion. Members are no doubt somewhat shy as yet; but continued personal intercourse will make them better acquainted with each other and will lead to mutual trust and confidence.

Company Reports.

We devote six or eight pages of this Magazine every month to abstracts of the reports issued by mining companies. Such reports are supposed to summarize the results of operations and to give shareholders a statement of profit and loss for the fiscal period. And in the main these reports do fulfil their purpose, but not all of them. Company reports come under four different categories, according as they are (1) prepared without caring whether they convey information or not, (2) intended to mislead, and (3) intended to inform, but fail to do so by reason of unskilful presentation, and (4) intended to inform and so well prepared as to be informing. We rarely abstract the first two kinds, as our space is valuable; we try to dig facts out of many reports belonging to the third kind; and we take keen pleasure in publishing a concentrate of the interesting information conveyed through the medium of the genuine report, last mentioned in our classification.

There are annual reports that give the price of candles but omit to state the cost of stoping; there are those that describe the local geology without giving a summary of the ore reserves; there are those that publish information a year late, and those that tell the shareholder everything except what he wants to know. But the worst sinner is the manager or secretary who goes through the motions of giving information, observing the letter of the custom but evading its essential purpose. On the one hand we have a long array of figures concerning cross-cuts and levels, with a bewildering quantity of trivial data, quite useless to shareholders. On the other hand we have an entire absence of details, which are replaced by general statements disclosing none of the facts essential to an appraisal of the enterprise. Both types of reports evade the issue. What is needed is the frank statement of a man to his partner, of a trustee to his clients, of an agent to the owners. A high assay in a drift may have no particular significance if it is obtained under a block of ground that is mostly worked out already or in ground previously tested by a winze; and it may mean the beginning of a new mine if obtained in virgin territory and confirmed by later assays. The mere piling of figures and the weary tabulation of assays will not help the shareholders unless the manager interprets the information in the light of his intimate knowledge of the mine. And he is engaged by the directors—who act for the shareholders—to do this, and to do it in language that cannot be misunderstood. We know that many company officials regard reports as necessary evils, but to our mind such officials are themselves unnecessary evils. Of course, reports are futile if meant to be futile; of course they serve no useful purpose if intended merely as a sop to Cerberus. But the public has reason to be thankful that custom and law have combined to impress upon modern directors a proper sense of the duty they owe even to the minority shareholder; and our pages testify, by the abstracts published under 'Company Reports,' that these documents constitute an invaluable record of the progress of the industry.

PERSONAL

JOHN H. ALLEN has gone to Kyshtim, in western Siberia.

PHILIP ARGALL announces that he has taken two sons, Philip Henry and George Oates, into partnership, with offices in the Majestic building, Denver.

H. C. BAYLDON has left for Kotchkar, where he will represent the firm of Hooper, Speak, & Feilding.

A. C. BEATTY has returned to New York, but he will be in London again next month, having opened a branch office at No. 1 London Wall Buildings.

W. K. BETTY is on his way to South Africa, after a tour in America and Canada.

W. BROADBRIDGE has gone to West Africa.

GERALD M. BROWNE is in Venezuela.

DONALD CLARK has been appointed lecturer on metallurgy in Melbourne University.

J. H. COLLINS is taking a holiday in the South of France.

T. L. DAWSON is manager for the Colombian Mining & Exploration Co., in Colombia.

J. V. N. DORR has moved to larger offices in the Equitable building, Denver.

HOWARD W. DUBOIS has returned to Philadelphia from Canada.

GEORGE E. FARISH has joined his father, John B. Farish, who has offices at Denver and New York.

W. E. GORDON FIREBRACE and CLAUDE VAUTIN are on their way to Chile, visiting Bingham and Ely first.

W. H. FREELAND is retiring from the management of the Ducktown Smelting company, in Tennessee.

SELWYN GOLDSTEIN is now in charge of the Tominil mine, in Mexico.

WILLIAM GOWLAND has been appointed Emeritus Professor of Metallurgy in the Royal School of Mines.

ANDRE P. GRIFFITHS is returning from Brazil.

ROBERT HAWXHURST Jr. is in Roumania.

HENRY HAY will be leaving South Africa shortly to go to West Africa as representative of the Gold Coast Amalgamated.

ALEXANDER HILL is at Huelva, Spain.

BERNARD HILL has been appointed assistant underground agent at the Ooregum mine.

C. S. HERZIG has joined the firm of C. L. Constant & Co., New York.

J. POWER HUTCHINS is expected in London from New York, on his way to Siberia.

A. McA. JOHNSTON is on his way back to Johannesburg.

H. EWER JONES is here on a holiday from Bulawayo.

L. K. KENNEDY, formerly at Juneau, Alaska, is on his way to Johannesburg.

H. H. KNOX is expected from Spain.

ARTHUR H. LAWRY, owing to an attack of malaria, has returned from Nicaragua to San José, California.

ERNEST LEVY was in Colorado recently.

HAROLD A. LEWIS is at Cobalt, Ontario.

W. J. LORING sails for Australia on February 16, to make a tour of inspection.

F. LYNWOOD GARRISON has returned to Philadelphia from Mexico.

H. G. NICHOLS has sailed for Johannesburg.

WALTER G. PERKINS has been engaged to superintend smelter construction at Kyshtim, in the Ural region.

HAROLD RICKARD is at Kingston, having returned from Mexico.

LEO VON ROSENBERG is in Peru.

ALFRED J. G. SWINNEY has returned to England from the Dutch East Indies.

J. B. TYRRELL recently delivered a series of lectures on 'Placer Gold Deposits' at McGill University, Montreal.

W. W. VAN NESS has taken larger offices in Salisbury House, London Wall.

H. R. VAN WAGENEN of Zacatecas, Mexico, has been in London.

E. C. VIGEON has been appointed manager for the United Rhodesia Goldfields.

P. B. WAUGH sailed on February 3 for Italian Abyssinia.

H. H. WEBB is on his way to South Africa; he will go to Johannesburg and to Rhodesia.

W. H. WEED is at Ely, Nevada.

S. H. WIMBERLEY, lately at the Homestake, is in London.

ERNEST R. WOAKES came over from Spain during January.

METAL MARKETS

COPPER.

The New Year was ushered in with great buoyancy based on the excellent trade reports received from all quarters; speculators gave large buying orders and consumers were purchasing freely. Standard copper stood at £62. 1s. 3d. for cash and £63 for three months. The New York stock market, however, with which the copper market is unfortunately so much bound up at present, very soon gave signs of breaking. A sudden rise in the rate for call money in New York, increasing fear of labour trouble on the railroads and especially threats of anti-trust legislation by the American President combined to produce a feeling of uneasiness among Wall Street traders which soon affected the feeling on the copper market and during the rest of the month an unsteady tone prevailed with little rallying power in prices. In this country election excitement has kept down the demand from producers although trade conditions continue excellent, both India and Egypt still taking good lines and the French electrical trade showing splendidly. American consumers too have purchased largely at full prices, especially in the form of wire-bars, showing that the electrical industry is very fully occupied. Indeed in this branch record consumption figures are promised for this year. Towards the end of the month the American purchases have also fallen off, but there is reason to expect that with a settling down of the stock markets which are undoubtedly having a disastrous effect upon trade in general this demand will also revive.

The American producers' figures for December showed a decrease in stocks of over 5000 tons. Exports for January reached the very satisfactory figures of 26,598 tons, while reports show that the deliveries to American consumers are on an unprecedented scale. At the same time production has decreased both voluntarily by the agreement come to between the leading producers and also through closing of the Butte mines, the railway strike, and the delays on the railroads due to the weather. The statistical position shows a very material improvement, while the large liquidation of the bull account has produced a technical improvement in the speculative market. Producers both in Europe and America are exceedingly firm and are not to be influenced by the flurry in stocks.

On the whole the firmness of the copper market in the face of so many disturbing factors impresses us as to the soundness position.

Average prices of cash copper:

January 1910.	December 1909.	January 1909.
£61. 0s. 10d.	£60. 1s. 0d.	£61. 6s. 7d.

TIN.

Tin opened with pronounced weakness which carried prices down from £154. 10s. 0d. three months, when the year's markets opened, to £149. 12s. 6d. within the first week. The market was very sensitive during the whole month, although unusually free from excitement in the absence of manipulation by the leading cliques which dominate it, and prices further sagged gradually away until £147 three months was reached. From that point, with narrow fluctuations and a small turnover, the market gradually recovered to about £149 and closed with a hesitating tendency and a disposition to await developments. Consumption remains good. At the Banca sale 2170 tons were disposed of at an average of £147. 10s. The East has sold sparingly.

Average prices of cash tin:

January 1910.	December 1909.	January 1909.
£148. 3s. 6d.	£149. 2s. 3d.	£127. 7s. 3d.

LEAD.

Lead has remained comparatively firm during the month. The better tendency noted during December continued until the end of January when the general depression adversely affected the price. Consumption has been satisfactory and large quantities of lead which have reached London have been absorbed without apparent effort.

The average prices of soft foreign lead have been as follows:—

January 1910.	December 1909.	January 1909.
£13. 13s. 10d.	£13. 2s. 10d.	£43. 3s. 6d.

SPELTER.

The revival in the galvanized iron trade still continues and no falling off is shown as yet in the amount of business done. The exports of galvanized iron for December were the highest on record. The yellow metal trade has also taken good quantities of spelter.

The average prices of good ordinary spelter were as follows:

January 1910	December 1909	January 1910
£23. 4s. 2d.	£23. 1s. 3d.	£21. 6s. 3d.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Stope-Drill Competition.—The popular indifference to all rumours and reports concerning the progress of competition initiated by the Government and Chamber of Mines is remarkable; to those who recollect the semi-political chorus of glad shouts with which the competition was heralded, the present apathy is even amusing. This attitude is not due to any slackness on the part of the mining world to appreciate reliable data concerning underground economics, but is a natural sequence to the fact that (1) engineers closely acquainted with the results find there is little or nothing to learn, that has not already been proved under less elaborate but no less instructive conditions, and (2) those who are not favoured with official reports hear nothing of any utility, and are only given a few scant data regarding some selected run on the granite block or in the stope. Permission is freely granted by the Competition management to enable interested persons to visit the workings of the New Comet, Village Deep, Robinson Deep, or wherever the trial is in progress, but the results obtained to date are not available. It is at least common knowledge that the only surviving drills are the Siskol, Holman $2\frac{1}{8}$, Chersen, Holman $2\frac{3}{4}$, and New Century, placed in the order of merit that I believe will be finally determined. Working with an average air-pressure of about 70 lb., the leading machines have recorded an average of about 30 ft. per shift of 8 hours. The Siskol, a new machine to the Rand, will no doubt profit by recent experience and appear on the market in improved form; it has generally been drilling 5 ft. holes, as compared with the 4 ft. most suitable for the other machines. As for the incidence of air-consumption and maintenance costs on the general merits of the different drills, there is unlikely to appear any weighty factors to prompt differentiation. It is said that the Siskol is proving much more expensive in maintenance, but this is probably due to the cost of importing parts or of getting single parts made locally, rather than any weakness of construction. When the drill is established, the cost should be levelled down to the average of, say, £3 per machine per month. The Holman and Chersen drills are well known in local practice, the former having been given an extended trial in the New Kleinfontein in 1908, with results showing that under some conditions small drills are as economical as hand-labour. The Chersen is known to be a rapid drill, but it has a name for being more difficult to manage than the others. It is noteworthy that all the machines surviving are of the reciprocating type. The Stope-Drill Competition leaves us still far from finding mechanical means for economically supplanting Kaffir hammer-boys, but when a shortage prevails the relative merits have to be ignored. We must then determine whether the big or the small drill should be employed. It can only be said that the results of the Competition may lead to a gradual development in the application of the light drill, which still stands behind the big machine in the majority of cases.

Dividends. The declaration of Rand gold mining dividends for 1909 at £9,238,396 has caused general satisfaction, for the increase of £668,480 is greater than was expected. Working profits have not increased commensurately, showing that it has been found safe to distribute a greater proportion of the working profits to shareholders. During the last six years, the Rand aggregates have been: 1904, £3,937,624; 1905, £4,754,348; 1906, £5,565,969; 1907, £6,962,416: 1908, £8,569,916; and 1909, £9,238,396. There were four new contributors to the list in 1909 and the Wolhuter again distributed dividends after a long term on the sick list.

New Rand Ltd.— The Rand is proud of the publicity it gives to the results of operations and was little short of indignant at the recent suggestion of abolishing the monthly analytical output statements. But things can easily be carried too far. For example, the explicitness of the many reports issued by the New Rand Ltd., which is boring for the Main Reef at the southern rim of the Witwatersrand basin, is positively embarrassing. It is a wonder that even domestic details of the manager's household arrangements are omitted. It is not as though the company's bore-holes ever struck anything of importance. As one would expect from the pen of A. R. Sawyer, the reports are unimpeachably accurate in their facts ; but it is a fallacy to suppose that shareholders in a diamond-drilling proposition require reports strictly proportional to the footage sunk in a ratio of 1 : 1. A report issued by the New Rand in October has been followed by another in December occupying a page and a half in the *South African Mining Journal.* Every quartz grain exceeding the size of a canary seed appears to have been faithfully described in a brief treatise and its relationship to a similar grain encountered in another borehole or another district duly noted. When a pebble occurs or something of a chloritic nature, there is a big stir among the company's assayers, who must now be highly accomplished experts in delicate balance-work with light riders. It is only remarkable that a few feet of core can be made to provide the requisite number of assay-tons for a weighable bead of gold. Having read the New Rand's reports upon 11 boreholes, one hesitates to speculate upon the verbal consequences of a rich strike, should it ensue. It is to be feared that by the time the appropriate report—geographical, historical, geological, and industrial —is written, printed, and circulated, the Rand will have been worked out and the capital and labour departed. However, the leading spirits of the concern are commendably persevering. Mr. Sawyer has returned to England for fresh capital and before his departure joyfully announced cutting the 'Red Bar.' There is certainly a bed of gritty red sandstone under the Main Reef for several miles in the central Rand, but elsewhere there is no such reliable 'marker.' Red sandstones are too common in the Witwatersrand system at various horizons. "Put not your faith in colours" is axiomatic in Transvaal geology, as elsewhere.

Coal and Gold.—The announcement that the Springs Mines company has struck a thick seam of excellent coal at a shallow depth in the vertical shafts now being sunk to cut the gold-bearing 'reef' at from 3000 to 4000 ft., once more emphasizes the Rand's wonderful good fortune in possessing fuel of good quality in abundant quantity within easy reach. The coal found overlying the East Rand basin is not as a rule as valuable as that of Witbank or Middelburg, but it is nevertheless highly serviceable. It is a common theory that Transvaal coal improves in grade from West to East, and in support of this idea the poor quality of the most westerly deposit (a basin of coal on the farm Cyferfontein, 12 miles south of Roodepoort) is cited ; as a matter of fact, little trustworthy data regarding this deposit is available. The prospecting done on Cyferfontein was limited and the mine was full of water for many years, until it was unwatered last year by Mr. Harper, as a possible factor in electric power scheme negotiations. Reliable information is still insufficient, but I understand that the reputation of this West Rand coal has been greatly enhanced by the recent investigation, although it will not play a part for the present in power schemes.

Graphite.—In view of the unprosperous records of Transvaal and Natal graphite prospecting in the past, the reports to hand from the new prospect on Goldehoep (northern Transvaal) are satisfactory. There is stated to be 2000 to 3000 tons of graphite exposed. What evidence there is of persistence is not declared. The aim of the Transvaal Graphite Ltd. (which is run by men of good standing and not a market concern) is to manufacture graphite products locally, for sale to the mines and railways.

Mining Regulations. — It is a common complaint among local mine managers that the mining regulations of the Transvaal are too numerous and detailed. The Government must, of course, protect the workers to the best of its ability by enforcing the utmost precautions consistent with mining economy. The question is whether a few important regulations would not be better observed than a voluminous budget, in which the urgent prohibitions are diluted with trivial and formal injunctions of little significance. It is announced that several new regulations are now being introduced with regard to the control of dams and trenches possibly endangering mine workings. The Knight's flooding disaster of last year was a better warning than any verbal caution of the Government, which has in the existing regulations ample means for punishing carelessness. We may almost expect to see the introduction of regulations prohibiting managers from hanging employees for insubordination or enforcing them to keep proper watch upon all portions of the mine liable, by caving in, to kill not less than 250 persons.

Surveyors and Samplers.—The recurrence of two advertisements for "two assistant surveyors" and "two assistant samplers" in Johannesburg papers may have caught the eye of oversea readers and led to the impression that there is a dearth of men to fill these subordinate staff positions upon the Rand, for the need of advertising is exceptional. While the mines are nearly always ready to provide footing of some sort for promising young men of good training, it cannot be said that there is now any lack of material. The Transvaal University College, though it has some way to go before reaching the standard of European or American mining schools, is nevertheless turning out graduates of good calibre, and the influx of fresh blood is steady. Nearly all new men, of whatever training and though experienced in work on other fields, are at first employed as mine samplers. Consequently the sampling staff on a mine is continually changing. The mine surveyors commonly are less anxious to seek other kinds of employment, but it must be confessed that the positions of shift-boss and mine-captain have lately been made so much more attractive in their status and prospects, that there has been a large exodus from the survey offices to the stopes. In consequence mines occasionally feel the want of competent certificated mine surveyors. The Government examination is difficult for any surveyor without local experience or without a good mathematical grounding, to pass, and the incentive to acquire the necessary knowledge is dispelled in the eyes of many by the poorer prospects of successful promotion to a management offered by the surveyorship than by the mentally less exacting billet of mine-foreman. The survey office wins the bad reputation of becoming a professional *cul de sac*, or at all events a position from which it will at some date be necessary to step back to make a better leap. This is an administrative mistake. As the tendency is to appoint managers from the underground staff, the position of chief surveyor should be elevated to one of higher importance in the control of underground policies and supervision from the broader standpoint. His pay might be raised 25% and his utility doubled, so that the surveyor could establish himself with contentment and be thus deterred from for ever casting around for an opportunity to forsake his scientific work in favour of supervisory duties underground.

Foundations for Randfontein Central 600-stamp mill.

Cape Colony Gold.—The Cape has been unfortunate in its gold deposits, but still more unfortunate in the character of the investigations made by local exploration syndicates. A typical report has just been published from Prince Albert to the effect that "Mr. Gurling Pritchard, A.I.M.E., has just succeeded in striking a gold reef in three places on the farm Spreuwfontein, 20 miles distant. The reef, which is 2 ft. 9 in. thick, dipping south at an anticline of 45° is porphyry rock, intercepted with red quartz. Assays show 16 dwt. to 18 dwt. per ton." This sort of statement more usually emanates from the Knysna district, to the south, where the Table mountain conglomerates, with their small gold content, are periodically re-discovered and boomed, and where a new company has lately been formed with about as little chance of success as had its now defunct predecessors.

Klerksdorp. — With the closing down of the Niekerk (whose plant is now being sold, some going to the tin districts and some to local mines) and with the failure of the tributors on the Klerksdorp Gold & Development Co., Klerksdorp has suffered another blow. But the district is used to hard knocks and speedily recovers. The West Bonanza, the Machavie, and a little proposition run by W. T. Pope are now producing. Work is proceeding actively upon the Afrikander and the Rietkuil. The most interesting revival, or promise of revival, in the district appears in the operations upon the once famous Buffelsdoorn, at one time managed by the late Wager Bradford. The workings, after ten years' neglect, are being unwatered and it will depend upon the results of investigations by the manager, G. Holmes, whether the mine is again pushed to the producing stage. From a high-grade mine, with a big width of ore, the Buffelsdoorn fell away to a low-grade property. Exploration may have been insufficient to condemn it. The 'reef,' largely of quartz and characterized by the presence of much carbon, with which the precipitation of gold is doubtless associated, lies in the Witwatersrand formation, at an horizon probably not far removed from that of the Main Reef. Stratigraphical correlations have proved of small service in the Klerksdorp district hitherto and the Buffelsdoorn is no exception to the rule that in prospecting the Witwatersrand formation beyond the Rand, one should find the payable lode first and consider its geological identity afterward.

MELBOURNE.

Coal Strike. — The development of the Newcastle strike is of the utmost interest to the student of the social and economic problems. The whole of Australia is being held up by a band of extremists in New South Wales. On the side of the public are ranged the leaders of other labour organizations, who are striving in vain to bring the trouble to an end. They must support the men on strike or they lose their positions. They cannot order a general strike because they know that public sentiment would be aroused against them at once. Then appears Mr. Wade, Premier of New South Wales. He let the two labour parties fight it out among themselves. Seeing at last that no good resulted, he has interposed with anti-strike legislation, and thus has dealt the severest blow to unionism since that form of trade combination was started on this side of the world. Stated broadly, the point taken is that there must be no interference with "necessary commodities": these are defined as coal and gas, for lighting, cooking or industrial purposes, water for domestic purpose, and any article the deprivation of which might endanger human life. Then the police are to be allowed free entry to any meetings and even to force their entrance whenever such meetings may be deemed in restraint of trade. All meetings where two or more persons assemble for the purpose of instigating or aiding in a strike or lock-out are declared to be unlawful and the penalty for taking part or aiding in the continuation of a strike or lock-out in respect to any necessary commodity or transport service involves 12 months' imprisonment. Any person entering into a combination for the restraint of trade in detriment to the public is liable to a fine of £500. The immediate effect of this legislation was to call forth from Mr. Hughes, the labour leader, a violent attack on Mr. Wade. The Premier pinned Mr. Hughes down at once and to the satisfaction of the public proved that while he had not been guilty of extending the area of the strike, he had not done anything to bring it to an end. Mr. Hughes thereupon dramatically declared that he withdrew from the dispute and threw all responsibility on Mr. Wade. Mr. Wade's rejoiner was to take a holiday trip to New Zealand. This meant that having got the power he intended to apply it. The law must prevail. Federal members are aghast at the Wade denouncement, but they are not prepared to assemble and urge a continuance of the strike. The socialist element, however, will do this and so widen the rift between themselves and the labour moderates. An absolute breach will make for industrial peace and the hope of thoughtful men is that such an end is near.

North Queensland.—The Treasurer of the State, Mr. Hawthorn, in his budget speech speaks of good prospects in several of the deep-level mines of Charters Towers, of railways extended to new mineral districts, and of steps being taken to promote mining in various districts. The good feature of the speech is that the Government intends to rely on private effort. The railway to the Mount Elliott and Hampden mines is being built rapidly. In the meantime the equipment for the Mount Elliott mine is being re-assembled. This is costing a great deal of money, but the outlay is necessary. Development at the Hampden mines has exceeded expectations, and in the Hampden itself a large quantity of ore is being exposed; but the chief asset of the company is the Duchess claim, where a magnificent shoot of ore has been developed down to the 260 ft. level. The ore has ranged from 8 to 30% in one body 280 ft. long, besides other runs of ore, some of it containing 15% copper. As the lode at the surface was only about 2 ft. wide and as it has opened out to a large body below 200 ft. the development at 400 ft. will be worth watching. Should the formation open out there as on the levels above, the Duchess will be one of the biggest mines in Queensland. The smelting plant is to be erected as soon as possible. At the Mac-

Gregor mine also the formation has been proved sufficiently for the board to plan for a smelter. At the Mungana Chillagoe matters have not progressed smoothly and there has again been a resumption of the trouble between the Chillagoe company and the members of the board that represent London interests. Godfrey Mackinnon, therefore, has declared his intention to resign. John L. Wharton succeeds him.

Zeehan.—British capital in large amounts has been invested in mines at Zeehan (Tasmania); hence fears over the fact that the lodes have lost value in depth. The most despondent view was taken by the Zeehan-Montana company, the chairman of which in London recently affirmed that "the lodes continue, but the shoots of ore do not." Such an assertion occasioned the gravest anxiety in Tasmania; the Government of the State at once directed W. H. Twelvetrees, the Government Geologist, and L. Keith Ward, his assistant, to examine the district. Mr. Twelvetrees is a man of ability and wide experience; he and his assistant spent three months over their task and they are now preparing a bulletin. To allay anxiety they have issued a preliminary report. Zeehan goes back to 1882, so that it is senior to Broken Hill; but it was not until 1892 that serious mining was started. Since then the district has been a consistent, though not a great, producer of high-grade silver-lead ore. The conclusions drawn by Mr. Twelvetrees respecting the genesis of the ore deposits is that there was a granitic invasion following closely upon the deposition of the Silurian sediments, that during the cooling of the granitic magma the metallic contents were expelled into the surrounding country-rocks in solution, and then deposited in the channels of circulation. Since the Mesozoic era erosion has resulted in the exposure of the granite and its metalliferous mantle. The Zeehan-Montana company has gone down 1000 ft. in its Western mine and 800 ft. in its Montana mine. The examination made by Mr. Twelvetrees has disclosed that the big slide in the Montana occurred prior to the lode formation. This is an important piece of geological evidence, especially as it has been discovered that ore exists north of the fault where previously it had not been found. It is admitted that the ore-shoots are shortening and cutting out in the bottom levels on the south side of the fault, but Mr. Twelvetrees holds that, since the origin of the ore is deep-seated, only sinking is required in order to intersect new orebodies. To buttress his deductions he points out that the gangue of iron carbonate is persistent and unchanged at the bottom level; that the silver ratio of the ore is unaltered; and that the main slide, which is the great indicator of the proximity of payable lode-stuff, in all probability descends to great depth. He also urges that as the best ore comes from near the region of the slide the horizontal extensions of existing workings should be advanced near to it. These are the general features of the report. The arguments are stated with much skill and the Government of Tasmania appears willing to assist deep exploration.

Tasmania

Tin mining in Tasmania just now is flagging. The attempt to work the shallow alluvium with dredges has failed. This is due to two causes: First, the dredges were too light. Then, it was found that the timber was heavy; and finally it was ascertained that in most cases the runs of tin were concentrated in comparatively narrow channels. These are fairly rich and yield from 8d. to 1s. per cubic yard, but there are so many blanks, so many variations in the yield, that the enterprise as a whole has been deplorably disappointing.

Moreover there has been the difficulty of saving the tin. The shaking and jarring of the dredges, the care that has to be exercised in regulating the water in short sluice-boxes, and the loss of the tin through its being carried off in the clay all have contributed to the financial failure. One dredge alone is at work now—the Dorset. As the difficulties of the work are better understood a hope exists that operations will be less disappointing than heretofore.

Dredging in Siam.—Public curiosity has been exceedingly keen in respect of Australian tin ventures in Siam. The pioneer company is the Tongkah Harbour, which controls 6 square miles of dredging ground. The report and balance sheet of the company for the past twelve months is now out. Speaking roughly, the figures disclose that the yield has averaged 1s. per cubic yard and that costs have amounted to 7½d. per yard. The profit left would, even with such high costs, be satisfactory if it were not for the small quantity of gravel handled. The company owns three dredges, but the loss of time seems to average between 30 and 40%. This is excessive for new plants; besides causing an inadequate yield, it spells high costs. Two of the dredges are Dutch and one is of British make. The fault appears to be in lightness of construction.

Broken Hill.—The latest news is the purchase by the Broken Hill Block 10 Company of the South Comstock mine near Zeehan, Tasmania. The lodes are large but the ore is complex, containing copper, lead, silver and zinc. The property was offered to the Block 14 company, which turned it down. Now Block 10 has jumped at it. The price is not disclosed and it came rather as a shock to the directors when *The Argus* published the news. The reason for the purchase is that the Block 10 company anticipates the continuance of conditions such as exist in the Block 11 mine of the Broken Hill Proprietary; the lode in the Block 10 is narrowing on the bottom level and toward Block 11 no ore is extracted; so the word was given to look round for another mine, and the Comstock group has been selected.

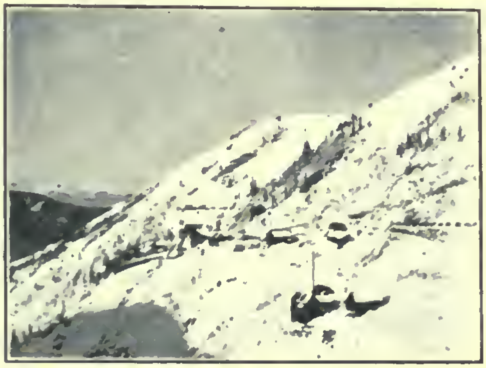
DENVER.

Mineral Industry of Colorado. — New Year has come and gone, and with its passing there has been much figuring of outputs and prospects. Local statisticians have tried to prove that each camp is the most important, or has had its "banner year," or is just "on the eve of its greatest prosperity." The last has been the favourite phrase and it must be admitted that there has been some little justification in that conditions are undoubtedly improving rapidly. The last two years have been hard on the mineral industry of Colorado. Times have been distinctly dull, but casting up accounts at the end of 1909 it has been found quite generally that net results have been better than had been anticipated and a distinctly hopeful tone has replaced the expectant one which prevailed during so much of the year. Machinery houses all report receipts of orders, and a much greater volume of business than for some time past. Accurate returns for the State as a whole are not yet available. The American Smelting & Refining Co. announces the metal output of its Colorado plants in 1909 as in the above table.

Source of Ore	Tons Dry	Gold oz.	Silver oz.	Lead lb.	Copper lb.
British Columbia	4,379	269	103,752	266,655	27,080
Colorado	533,750	269,776	7,932,033	59,039,249	10,177,860
Canada	12,931	———	2,528,349	———	42,424
Idaho	84,192	209	2,067,412	82,698,220	324,112
Montana	1,758	107	47,016	15,066	84,067
New Mexico	190	61	2,517	166,075	1,136
South Dakota	4,640	3,757	11,935	———	137
Utah	5,026	162	184,164	2,396,875	124,322
Total	646,866	274,341	12,877,178	144,582,140	10,781,138

Smelting Plants.—The Modern Smelting & Refining Co., which late in the year blew in its new furnace at Utah Junction, reports an output of 7230 oz. gold, 50,300 silver, and 128,500 lb. copper. The North American Smelter & Mines Co., which is re-opening the Golden plant, has not yet begun to treat ore. The smelters, however, are not now so important as formerly. The Durango plant was the only one that ran at full capacity, those at Denver, Pueblo, Leadville, and Salida having only about half their furnaces in blast. Within the year it was determined, as already related, to close the Argo permanently. Mills now handle the largest part of Colorado ore and by development of new processes and plants the mine operators are getting out from under the domination of the smelting trust.

New mills. — The striking feature of the year, metallurgically, was this development of mills. The mill using the Malm process at Georgetown is not yet ready to run, but the Stratton's Independence plant has made so good a record as to lead to enlargement. The Portland company has nearly completed a 400-ton plant to treat low-grade ore and dumps. Details have not been made public, but it is known to be a non-roasting process whereby tellurides are broken up and the gold dissolved as in cyanidation. The exact solvent used is a secret, the process having been discovered in the company's own laboratory. It is enthusiastically claimed that it will be possible to treat profitably all ore worth more than $1 per ton. The mill is situated on the east slope



Smuggler-Union Mine, Colorado.

of Battle mountain near Shaft No. 2. The dump, which is estimated to contain 2,000,000 tons, is to be handled by caving, the ore being delivered to electric cars in a drift below. These will carry it to the shaft where it will be hoisted and delivered to bins of 500 tons capacity. The bins are of steel construction, cylindrical in shape, 36 ft. high and 26 in. diam. The bottoms are of concrete, and the ore is to form its own angle of test, being drawn on a steel conveyor, 4 ft. wide and of variable speed. This principle, by the way, has been applied with marked success in the coarse-crushing plant of the Boston plant at Bingham, Utah. The ore at the Portland is to pass from the conveyor under magnets to remove stray nails and steel. From the magnets it goes over a grizzley, which delivers the coarse to a large Blake crusher. From the crusher it goes to two sets of 24 by 48 in. Colorado Iron Works rolls set tandem with impact screens between. These are said to be the largest rolls used in a Colorado mill and have an estimated capacity of 1200 tons per 24 hours, crushing to 3/8 in. From the rolls the ore goes by conveyor belt to four Akron 6-ft. Chilean mills through storage-bins with automatic feed. It is to be crushed here to 30 mesh in cyanide, and the new solution, and to travel next to concentrating tables. The concentrate will flow by gravity to a 1000-ton bin having a filter-bottom through which the solution is to drain. From the bin the concentrate may be dumped into freight cars and shipped to the company's mill at Colorado City for further treatment. The tailing from the tables will be sent through Akins spiral classifiers, the slime passing to Rothwell de-waterers, and the sand to second and third Akins classifiers to be washed with fresh water and thrown away. The slime from the Rothwell de-waterers will be sent to a canvas plant for further treatment and concentration and finally through six agitating-tanks 36 ft. high and 20 in. diam. to revolving filters somewhat similar to the Oliver, and thence to the precipitation room. The whole mill is being built with an eye to automatic operation and low running costs. J. M. Tippett, the chemist, and Thos. B. Crowe, the metallurgist, have the best wishes of the camp and the profession back of them. It may be noted that in the use of concentrating tables, the Portland will resemble the Stratton's Independence mill. It will differ essentially in the introduction of a new solvent supplementary to cyanide.

Cripple Creek has had a prosperous year. The total production is figured at $15,850,113, a trifle less than in 1908, the decrease being due to the fact that so many of the big mines are waiting for drainage by the Roosevelt adit. This is making excellent progress and is expected in eight or ten months to reach the water-filled breccia. If the flow encountered be only as large as in the El Paso (7000 gal. per min.), it may be expected that the water-level will be lowered at a rate of 6 to 8 ft. per month. Since at greater depth the head will be larger, the flow should also be faster and even speedier benefits may accrue. The water present in the district is estimated at 46 million gallons per foot of depth, the figures being based upon the discharge at the El Paso adit. To pump this would cost, according to records, $125 per million gallons, and would entail a continued and unknown cost to take care of surface waters. The anxiety, therefore, with which operators await the completion of the drainage adit can well be understood. In the meantime, 17 companies have paid $1,103,488 in dividends of public record, and a large additional amount should be credited to close corporations and individuals. A number of interesting discoveries have been made in the course of the year. The Cresson, under the management of Richard Rollofs, has made an especially good record. The Vindicator has a new and good ore-shoot at depth. The Portland and Strong companies have reached a supplemental agreement respecting east and west dipping veins in disputed territory and have thus avoided costly litigation. Their conflicting rights regarding north and south dipping veins were compromised some time since.

SAN FRANCISCO.

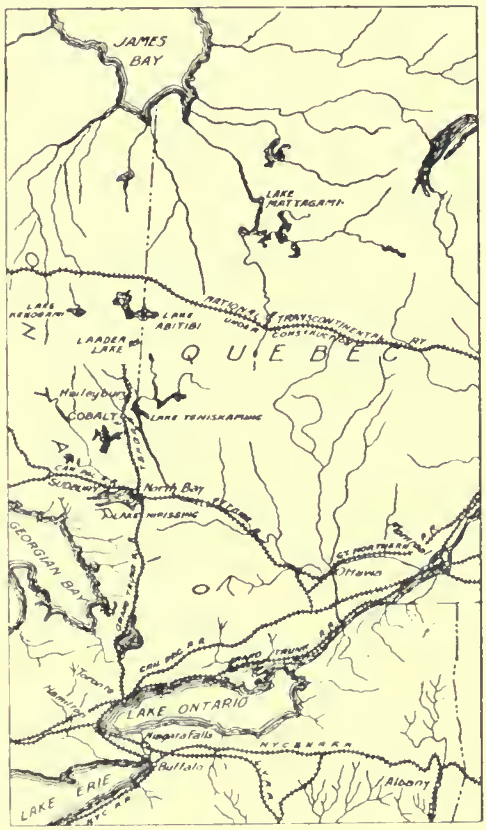
The Homestake mine in South Dakota has been forced by the attitude of the labour-union to cease operations, pending an adjustment of the difficulty. No questions of higher wages, or difference in hours of labour, have been raised; the trouble is simply due to the aggression of the Western Federation of Miners, which has been seeking to completely unionize the camp. The demand for recognition of the union and for the exclusive employment of union men was frankly made, and the superintendent, Thomas J. Grier, has frankly declined to submit. The closure of this great property in mid-winter entails much hardship on innocent workmen. Opinion among the miners is by no means a unit. Lead City is a place where the workmen have acquired homes, and where something like a genuine civic spirit has arisen, which is unique among Western mining camps. The company announces its intention to resume with non-union men, but it is possible that a compromise will be made to the extent of merely asking no questions as to the affiliations of the men. The real struggle, however, is yet in the future, and the strength that the Union may display is unknown. This is the first important labour difficulty that has occurred in the history of the Homestake mine.

Petroleum production is watched with much interest in San Francisco. California, Oklahoma, and Illinois are now the chief producing States and yielded in 1908, 45,798,765, 44,854,737, and 33,685,106 bbl. respectively, in all equivalent to nearly 70% of the total for the United States. In value the figures were, California, $23,433,502, Illinois, $22,648,881, and Oklahoma, $17,694,843. In 1909 Oklahoma and Illinois production decreased because of lower prices and lack of adequate transportation facilities, while California enjoyed higher prices and the production increased something over twelve million barrels. It may be noted in passing that in Oklahoma and Illinois the Standard Oil Co. is dominant while in California nearness to the sea and resultant freedom of market has enabled the Associated Oil Co., the Union Oil Co., and a number of smaller concerns to maintain themselves against the Standard. Accurate statistics are not yet available, but the mid-continental field, essentially Oklahoma, is estimated to have produced 46,535,000 bbl. Illinois is estimated at 29,700,000, probably too low, and California at 57,551,723. The Coalinga field leads in California with 15,161,570 bbl., followed closely by the Kern River with 15,090,050. The Santa Maria is next with 7,995,085. In all 14 separate oilfields are now recognized here and the production of petroleum is the largest element in the State's mineral industry. At the beginning of 1909 production was about 6000 bbl. per day ahead of consumption, but at the close of the year conditions were reversed. The daily production is now about 158,000 bbl. from some 4000 wells. The average price per barrel in 1908 was 52¼ cents. In 1909 it was probably 56c., and it is expected in 1910 to be 60c. An attempt was made within the year to establish a 40c. price but this proved a failure. Development in most of the fields has been satisfactory throughout the year. Headway is being made in the Kern River field where the air - lift is being used in combating it. No new fields have developed, though the old ones have been notably extended.

Copper continues to hold first place in public interest. The proposed merger has been abandoned, at least so far as any public move is concerned, but production is growing rapidly, each company endeavouring to get in the best possible position with an eye to its rating in case of a future combination. In the meantime the combination of the Utah Copper Co. and the Boston Con. has been effected. Lafayette Hanchett, the efficient general manager of the Boston Con., has been given a year's leave of absence at full salary and will travel around the world. Louis S. Cates, mine manager, and A. J. Bettles, metallurgical engineer, have been offered positions with the Utah company, but have declined. The Utah mill is to be increased to 10,000 tons capacity so that a total of 17,000 tons per day can be handled by the company. W. A. Clark, in the meanwhile, is announced one day as favourable to a merger and the next as being opposed. It is hardly likely that the United Verde will be included in any combination, since Mr. Clark like a certain English statesman prefers the lonesome furrow. This he is abundantly able to do since the gold-silver content of the ore at Jerome gives him probably the cheapest copper in America. In that connection his statement that "it is impossible to mine copper with a fair profit under 15c." but that "the price should not, however, go above that" is extremely significant. Mr. Clark is the largest individual producer of copper and his mines have an output quite large enough to make it extremely interesting for any group proposing to maintain a price to which he does not agree. His coyness regarding the merger is, just possibly, related in some way to the proposed litigation against him by interests at Butte that are favouring it. Anyone proposing a jackpot is likely to hold cards backed by a big stack of blue chips.

TORONTO.

Porcupine Lake.—During the last few weeks the rush to this goldfield has continued unabated notwithstanding the season and the impossibility of doing genuine prospecting work when the country is covered with snow. J. F. Whitson, Assistant Chief of the Survey branch of the Provincial Department of Mines, who recently made an official tour of the district, reports that fully 2000 claims have been staked. Practically the whole of the townships of Witney and Tidsdale and two-thirds of the townships lying to the south of them have been taken up, and hundreds of prospectors are now doing development work. Mr. Whitson confirms the reports as to the value of the surface discoveries. A party of Cobalt mining engineers and mine owners returned this week from Porcupine all greatly impressed with the possibilities of the district, but disposed to advise caution until the lodes have been proved in depth. While some claims show gold at the surface, it is pointed out that several years ago locations were made, even on the large quartz veins, which on examination failed to prove remunerative. Most of the claims lately pegged have been located without any valuable discovery being made and in the hope of selling out to speculators at a good price. This method has resulted in such widespread loss to the public in connection with the Cobalt, Larder Lake, Gowganda, and other mining booms that Frank Cochrane, the Minister of Mines, has issued a warning against the purchase of claims staked out when the country is under snow, as there can be no certainty that they possess any mineral value. He intimates that it may be necessary to appoint inspectors to put a stop to wild-catting. Samples of gold-bearing quartz from the Wilson claim are on exhibition at Toronto. They comprise about 300 lb. from a vein about 60 ft. wide, which has been traced for a mile with gold showing throughout. One large piece was taken from 7 ft. below the surface. Henry Timmins has 35 men engaged in development work on the Hollinger claim, and a depth of 15 ft. has been reached, where the indications are as favourable as on the surface. Diamond-drilling is being done on M. J. O'Brien's property where a large force is at work. W. J. Loring, representing the British firm of Bewick, Moreing & Co., has returned after an inspection of Porcupine Lake. He made no investments, stating that the prices asked for undeveloped properties were altogether too high, and he does not expect that any English capital will be attracted to the district until more development work has been done, or more reasonable terms can be obtained.



Part of Canada.

Cobalt has been overshadowed by the attractions of Porcupine Lake, the continued stagnation in the stock market being only broken by a temporary upward movement in Kerr Lake, on the declaration of a 10% dividend for the quarter. The total shipments of Cobalt ore during 1909 were 30,098 tons as against 25,463 tons in 1908. In December 2971 tons were shipped. The concentrating of lower-grade ore on the ground has been responsible for the decreased shipments from several mines. There is not likely to be much change in the situation until the introduction of cheap power gives an impetus to the development of a number of properties the owners of which have been anxiously awaiting this facility.

Asbestos. — The Amalgamated Asbestos Corporation, which in June last took over a large number of properties in Quebec, is planning to greatly increase the output during the current year. Improvements in the mill of the Dominion property will, it is anticipated, bring the output up to 7000 tons annually. The capacity of the Beaver mill will be increased from 375 to 650 tons per month. New crushers and modern machinery at the Standard are expected to bring the output from 3000 to 5500 tons per annum, and at the King's and British Columbia improvements in the process of handling the raw material will increase the product from 10 to 15%. In all, an increase of about 10,000 tons in the output of 1910 is anticipated.

Ore Stealing has attained such proportions at Cobalt as to seriously affect the profits of mining, and render stringent legislation necessary. A bill has passed its third reading in the Ottawa House of Commons making it a criminal offence to be found in possession of gold or silver ore, without being able to give account as to how it was obtained. This will render it considerably easier to secure convictions in cases of 'high-grading.'

Shipments of ore have been made from two mines in the Gowganda district, the Blackburn and the Reeves Dobie, which each consigned about 30 tons to the smelters.

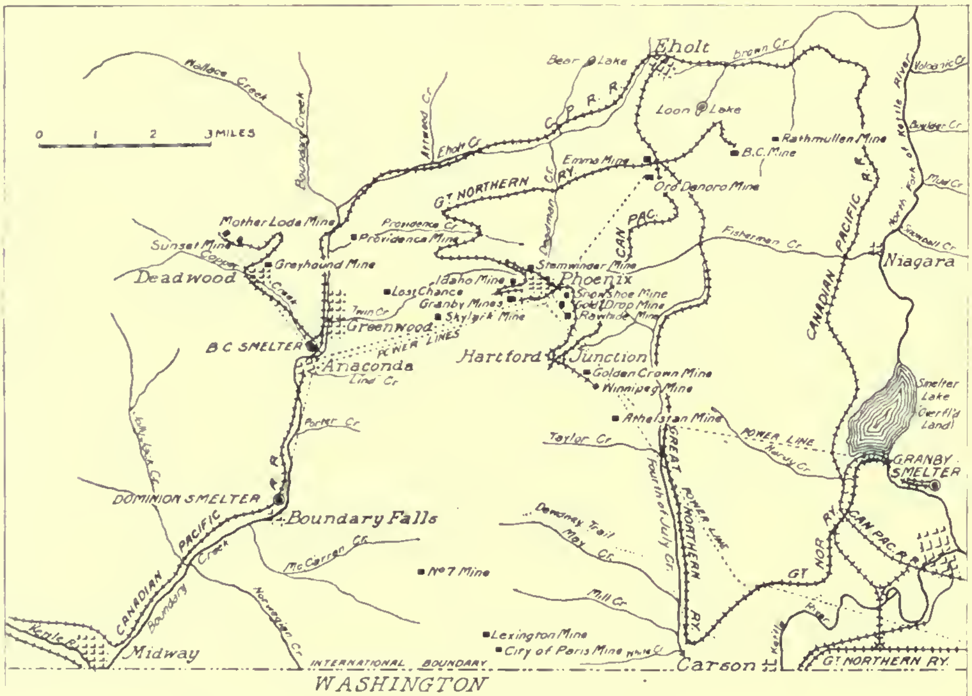
Nickel.—The Mines and Minerals Committee of the Canadian House of Commons has undertaken to investigate the nickel mining industry of Sudbury. Evidence was given on January 19 by Arthur Wilson, an expert who has been studying the situation ; he stated that development of the nickel resources was being retarded owing to the action of the International Nickel Co. of New York controlling most of the mines. They were keeping down production in order to strengthen the price, while deposits to the amount of tens of millions of tons were undeveloped. The export of nickeliferous matte to the New Jersey smelters amounted annually to 38,000,000 lb., and the loss to Canadian artizans owing to its being sent in a partly manufactured form instead of as a finished product amounted to about $1,000,000 per annum. He suggested that an export duty should be placed on such matte, and that the Government should encourage the making of nickel-steel in Canada. The committee decided to investigate the operations of the Trust, and will summon as witnesses the officials of the Canadian Copper Co., which is the local branch of the International organization.

ROSSLAND.

Mining in British Columbia during 1910 bids fair to do better than in 1909, the output for which showed an increase over 1908 and amounted to approximately $24,500,000. The Granby Consolidated last year increased its furnace capacity from 3500 to 4500 tons per day. It is not unreasonable to expect that 27,000 to 30,000 tons of low-grade copper-gold ore from its Phœnix mines will be treated by this company each week. This means a copper production of very nearly 600,000 lb. copper per week. This concern paid but 2% in 1909, but was under expense of nearly $250,000 for smelter and other improvements. A dividend of 6 to 8% on issued stock is anticipated for 1910, if all goes smoothly.

The B. C. Copper company is increasing its production. Three furnaces are running steadily at the smelter and with the receipt of ore from the mines of the New Dominion Copper Co. it may be necessary to install an additional furnace, increasing the capacity of the Greenwood smelter from 2000 to 2500 tons per day. The profits of this company for November amounted to about $54,000 and the cost of copper production was lowered to 7·35c. per lb. for the month ; of course, the figure for the year will be a few cents higher. The output of ore by Boundary mines in 1909 was over 100,000 tons greater than the preceding year, being nearly 1,600,000 tons.

The Consolidated Company of Canada has recently acquired the Ikeda group of 26 copper claims on Moresby island of the Queen Charlotte group, as well as the Sullivan group (silver-lead) in East Kootenay. The company is now working the Trail smelter and refinery, Centre Star group (Rossland), St. Eugene and Sullivan mines (East Kootenay) and the Snowshoe in the Boundary district. The Richmond-Eureka at Silverton is also being worked by the Consolidated and is producing steadily a $34 product. The output of the Centre Star is about 4000 tons per week of gold - copper ore. The company is now treating over 10,000 tons of mixed ore per week at its Trail smelter, mostly coming from its own mines. The Le Roi mine is shipping several hundred tons of picked ore per week to this plant and is working two diamond-drills in the lower levels. The Le Roi 2, Ltd., shipped over 700 tons to Trail smelter during the first week of the year. The Josie shaft has now been sunk to near the 1300 ft. level and the company is opening the ground between that level and the 900-ft. workings. While the gold production of Rossland mines dropped about 30,000 oz. last year, the outlook is better for the coming year.



PART OF BRITISH COLUMBIA.

Lead and Zinc.—The full bounty on lead (75c. per 100 lb.) was paid during last year, the total payments amounting to about $340,000. A bounty on zinc has been demanded and if the Dominion Government should grant it a great stimulus would be given to the zinc industry of British Columbia. The need of a local zinc-reducing plant is greatly felt. It is hoped that the Dominion Government will foster this industry and will extend aid toward the establishment of a local zinc smelter by offering a bonus. There is no doubt it would be paid back with interest in a few years. The Provincial government has already aided in the zinc electric-smelting experiments to the extent of about $25,000.

MEXICO.

Santa Gertrudis. — The year has opened favourably for Mexican mining interests. One great deal, the Santa Gertrudis, of Pachuca, has been brought to a successful issue, and in a few days the Camp Bird company will take over this famous property. The vein, which is owned in part by three different companies, namely, the Santa Gertrudis, the Barron (Real del Monte), and La Blanca, carries one continuous ore-shoot having a length of 2600 ft., and on the bottom levels, at a depth varying from 1500 to 1600 ft., the average value of the ore is over $23 per ton.

Cinco Minas. — Another mine that promises to prove important is the Cinco Minas, of Hostotipaquillo, on which the final payment was also made in the first days of January. The purchase price being 530,000 pesos, the amount paid does not attract attention, but as a matter of fact the ore-shoot developed during the time of the bond has proved to be worth close to two million pesos in positive and probable ore. This compares well with the Santa Gertrudis deal. The purchase of these two mines affords an interesting comparison, in view of W. A. Prichard's article ('Looking for Mines in Mexico'), which has attracted considerable attention here and has been copied by the daily Press. The Santa Gertrudis was purchased purely as a going concern, the Cinco Minas was bonded as an abandoned *antigua* with great possibilities. After bonding, an intelligent application of economic geology, together with bold and systematic exploration work, revealed a continuation of large and valuable ore-shoots, which had been lost by step-faulting.

La Reforma. — Another big deal that is pending is the purchase of the famous Campo Morado by the Exploration Company of London for 20,000,000 pesos. The Campo Morado district is controlled by a close corporation, the Reforma Mining and Milling Co., which is identified with the Ortiz family. The mines, which are in the State of Guerrero, consist of an immense orebody carrying lead oxides with from 750 to 5000 grammes in silver, and from 10 to 50 gm. in gold. This class of ore is found in the upper workings and in the oxidized zone, but in depths the ore changes to iron pyrite having from 3 to 8% copper and some silver and gold. This property will also be purchased as a going concern. Here there are splendid chances for both the economic geologist and the metallurgist, and also for the working superintendent who is a good organizer.

Rincon.—Another large transfer has been completed by the final payment of one million dollars on the Rincon mine, which is at Tamascaltepec in the State of Mexico. The mine was worked by Spaniards from 1800 to 1810 and produced between 6,000,000 and 7,000,000 pesos; work was suspended during the war of independence and the mine lay idle till 1831, when it was again worked for a short period. In 1888 a French company took hold of the property, but, owing to a large flow of water and other troubles with which they were unable to cope, they abandoned it in 1890. In 1892 Munusury and Santo organized a company, known as El Rincon y Anexas, and operated the mine until 1905, when it was turned over to Hugh McDonnell under bond. The mine is at present owned by the Mexican Rincon Mining Co. with a capital of $1,500,000. This company provided the funds for the final payment, as well as for development work and equipment. Major Gillette is president; Hugh McDonnell, vice-president; Marvin Lane is the treasurer.

Foreign Investment.—It has been estimated that fully 85% of all the mining operations in Mexico are controlled by foreigners, and the bulk of these operators may be classed as absentee landlords. Of the total investments probably 70% are under American supervision; English interests come next; French and German interests are relatively small, though some of the mines individually are of importance. There is a steady increase in the investment of British capital in what may be termed industrial mining, the acquirement of going concerns, and the installation of up-to-date methods, processes, and equipments, with the object of handling large bodies of low-grade ore at a small margin of profit.

While this kind of conservative business may appeal to a great many investors, the real opportunity in Mexico is in the acquirement of good prospects, which still abound, but more especially what may be termed obscure prospects, that is, partly developed mines that have difficult problems to solve, either engineering, geological, or metallurgical; what is needed is the establishment of well organized development companies in Mexico with at least one mining engineer and metallurgist and one economic geologist on the staff, both of whom should be men thoroughly acquainted with the country, customs, language, and people. Once let it be known that such companies existed with ample backing behind them, and innumerable prospects would be brought to their attention; these could be sifted by the local staff, with the assistance of local engineers; then the more promising would be tentatively developed, and out of say 20 examined, 4 might warrant further development work, and thus out of these possibly one or two would eventually become highly profitable undertakings.

British Agencies.—The British manufacturer of mining machinery and supplies does not get his fair share of trade in Mexico. This is partly due to faulty design; the bulk of British machinery being made too heavy and hence costing more to transport; but it is also due to the fact that the manufacturer does not protect his agent. This complaint is made on all sides. A good agent should be protected through thick and thin; he is then encouraged to push the sale, which it must be remembered requires financial support on the ground. Imagine the feelings of an enthusiastic agent who makes a hard and expensive journey to some mining camp, to close a deal, to find on his arrival, that some other machinery house has already quoted at his rate or possibly even lower, having cut out part of their own commission to ensure getting orders on some other goods that would compensate them for the loss. This not only discredits and disheartens the agent, but so disgusts him that he fails to make any special effort to push the article in the future. British merchants could re-gain a great deal of their lost trade here in Mexico by a judicious study of the requirements of the country.

The Mexican Institute is now just six months old. The roll of its membership now stands at 190, and includes the best known engineers and metallurgists in Mexico. The first honorary member to be elected was the Minister of Fomento, Don Olegario Molina, who has shown great interest in the Institute and every willingness to help it. Bulletins are published bi-monthly and contain a great deal of interesting data. The third number deals with the Pachuca meeting and is replete with historical, technical, and descriptive notes of this interesting district. The reading matter is given both in Spanish and English. At the last meeting a valuable paper was read by H. S. Denny entitled 'Some Observations on the Valuation of Ore Bodies,' which was really a discourse on an analytical method of ore-sampling. There was also a vigorous discussion on Leopoldo Salazar's paper on the 'MacArthur Forrest Cyanide Patents in Mexico,' which developed into a general discussion on patent law in Mexico, of particular interest in view of the proposed new Mexican law. The next meeting will be held by special invitation of the Government in the building of the famous old School of Mines.

MAP OF MEXICO.

CAMBORNE.

Tresavean.—The water was lowered last month to the 100-fathoms level but the continued heavy rains caused such an increase that the electrically driven pump could not handle the water, which rose to the 75-fm. level. The water is again lowered to that point. A station-pump is to be placed at the 75-fm. level although originally intended for the 100-fm. level. The pumps here have done well and have not given much trouble. The old engine-house originally used for two of the largest size of Cornish pumping-engines, first a 90 in. and secondly an 85 in., has been re-fitted to receive two 350 h.p. Belliss - Morcom engines, the wooden beams being replaced by steel girders. Three Lancashire boilers, 30 ft. by 8 ft. 6 in., supply the necessary steam for the electric pumps, electric winches, and hoist. This Glasgow company deserves to be rewarded for its energy and enterprise in attempting to unwater a mine 300 fathoms deep.

St. Ives Consolidated is a series of mines in St. Ives district, the best known of the group being St. Ives Consols, Rosewall Hill, Ransome, Giew, and Trenwith. The Giew mine has been unwatered to a depth of 260 ft. below the adit and it is reported that the lode carries from 30 to 47 lb. tin per ton for a width of six feet. The unwatering was done by Cornish pitwork worked electrically through reducing gear. This pitwork was in use when the mine was working formerly and although it had been under water since 1874, it was found in excellent condition. Apart from this tin discovery this group of mines is attracting much attention—if paragraphs in daily and weekly papers are any criterion—on account of the radio-activity of the waters, especially in the Trenwith mine. Norman Whitehouse has analysed the water and has reported that all the springs exhibit radio-activity to an abnormal extent. He finds that the water at Trenwith is twenty-six times as active as that of Harrogate, the famous Yorkshire spa, and about seven times that of Bath. Sir Frederick Treves recently lectured on 'Radium in Surgery,' and said "that radium would cure every form of nævus in the widest sense of the word." In conclusion, however, the lecturer stated "that extreme caution must be used in speaking of what radium was going to do else disappointment was sure to result."

Wheal Kitty and Penhalls.—These mines report a profit during the six months ending December 31 of £2385, and a dividend of 7½% will be paid this month and a balance carried forward of £1906. The Gooninnis sett situated to the south has been obtained from the Duchy of Cornwall on a 12 months' license in order to test the Flat lode. This lode at the time of writing going in the direction of Gooninnis is 3 ft. wide and worth 160 lb. black tin per ton. The Goonvean Clay Co., which has held the sett for some years, recently surrendered the unexpired term of 12 years out of a 21 years' lease. The drive and rises on the Wheal Kitty lode at adit in Wheal Vottle are opening up some excellent stoping ground. The lode is fully 4 ft. wide and averages 40 lb. black tin per ton. This level is going into entirely virgin ground.

Falmouth Consolidated.—These mines, hitherto known as the Wheal Jane, are situated in the Truro district, and should shortly be making returns, as the 20 stamps are ready to work. The mill has been much improved since it was closed in the autumn of 1908, five new revolving frames having been built to treat the residue from the Buss tables. The seven ball-mills that were placed in this mill in 1908 have been sold, and some of them will soon be at work at a mine about three miles distant. The ore above the adit at the Falmouth is complex and contains much iron pyrite. A trial-run has recently been made with the electric station-pump fixed at the adit 50 fm. deep, and it gave general satisfaction. The sinking-pump had a preliminary trial, but was sent back for a few alterations; it should be ready for work again in a few days. The mine is only 80 fm. below the adit.

Great Wheal Busy.—The 80-inch Cornish pumping-engine should soon be unwatering this mine. Three large Lancashire boilers are being installed, and a steam capstan to handle the heavy pitwork is in working order. The 19 in. column is in place from adit to surface, a distance of 50 fm. and the 17 in. main rods are now ready to be suspended from the 'nose of the bob.' The pipes or column below the adit are to be 22 in. diameter. It seems to be the general impression that the shaft, which measures 8½ by 5½ ft., is much too small for the pitwork. It is the intention to drain the mine to the 40-fm. level as soon as possible and from that point to explore the many lodes. A mill has been erected for the treatment of the tin ores and an arsenic refinery has been completed.

Basset Mines.—The report shows that Marriott's shaft is being sunk below the 310-fm. level for a sump before extending a cross-cut southward. Pascoe's shaft is being sunk below the 30-fm. level by 18 men at £37 10s. per fathom; and the level is being driven both east and west by means of rock-drills at a cost of £9 per fathom. The lodes are poor at present. The cost of stoping is about five shillings per ton. During the last four weeks, 2693 tons of ore was crushed yielding nearly 48 tons of black tin equal to 29s. 2d. or 40 lb. tin per ton.

Great Royalton.—The machinery at this mine will shortly be sold by public auction. This mine which is situated near Roche in the St. Austell district has had an eventful career since 1901, when as a prospect it was purchased by a wealthy man who erected substantial machinery for milling the large elvan course that was said to carry 15 lb. of tin to the ton. The man in charge as manager was an ex-army officer. In 1907 another company took charge, and erected all kinds of unproved patented machinery. During 1908, about £700 worth of tin was extracted from pillars left by former workers, and operations were then suspended. These two companies spent over £30,000 in machinery and its erection, and it is said that neither company sank a foot. The mine is only 20 fm. deep.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

The Engineer as Promoter.

The Editor:

Sir—The strictures you make on Mr. Hammond's advice to students are possibly based on misconception or incomplete appreciation of the position as it appears to him. On two occasions you have taken Mr. Hammond severely to task because he "would like to see the mining engineer acquire such a knowledge of business methods as to enable him to take the place of the mine promoter." If, however, we look at this expression of opinion fairly and squarely we see that this advice from one who has had no small experience of the purely professional and technical side of mining engineering is both reasonable and worthy of consideration. If for one moment we review the position in the allied professions of civil engineering and mechanical engineering, we find that the most celebrated members of both professions deem it not unworthy of their position to undertake the execution of huge contracts rather than rely upon consultative work pure and simple. Our great docks, tunnels, bridges, harbours, sewers, and underground railways all testify to this position, which after all is not unnatural. A keen, level-headed, business-like professional man is not content to remain at the beck and call of anyone who likes to consult him or prefers to do without his advice; so subordinate a position is in itself galling and would tend to keep out from the profession the best type of man, and therefore such engineers as may not have received government appointments are apt to blossom out as organizers and business men—in other words, as contractors or promoters of engineering enterprises.

And this position becomes still more marked when we turn to the field to which Mr. Hammond more especially applied his remarks. The position of a mining engineer is not altogether a happy one. At an early period of his career placed in charge of certain departments and subsequently in complete control of the operations of a concern, a time comes sooner or later when from necessity or from choice he relinquishes the position he has hitherto held—usually in some foreign territory—and returns to his native land to settle down in consulting practice. From this moment he realizes that the envied position is in reality apt to be a hollow one unless he can combine with his consultative position control of sufficient financial resources to enforce the carrying out of his suggestions.

It has been recognized long since that the position of consulting engineer to a mining corporation is apt to carry the responsibility for any inefficient working without any real control. One can refer without in any way taxing one's memory to case after case where the board of such a company engages on most technical operations, such as laying down a power-plant, providing an ore-treatment equipment, or installing some new type of hoist, without even mentioning the matter to their so-called responsible adviser.

Consequently, if we look around at the practice of our best established firms, we find they are not content to pose merely as consultative men, but that they aim at securing complete financial and technical control, including the appointment of the board; or failing this, they insist on having the offices of the company in their own buildings or at least on having a seat on the board. We may take it that the most reputable firms in the City of London are conducting their professional business on such lines as require the knowledge of business methods that Mr. Hammond advocates, and not a "mere limitation to the consideration of the academic features of mining problems," which he deprecates.

So far, then, it would appear that the practice of the best established firms of to-day is not so greatly at variance with Mr. Hammond's counsels. Let us, however, go farther. It is a matter of common knowledge to the profession that possibly the best of our mining engineering firms are ever eager and alert to learn of really good mining propositions which they can place before their clients; and that when sufficiently good propositions come along they arrange the financing of these as well as their technical operations. It is difficult, therefore, to see how the methods of some of our best firms, accepted as being entirely reputable, become worthy of the severest censure when put forward by Mr. Hammond.

But more remains to be said. Mr. Hammond expresses a pious wish to see "the mining engineer take the place of the mine promoter." Surely there can be, on cold consideration, only one expression of opinion with regard to this wish. Provided the mining engineer is content not to profit personally by the introduction of business to a company already paying him a fee for this purpose nor to dabble in the shares of the company he is promoting, but to take his remuneration out of the profits that he may make for his clients, then the substitution of the mining engineer for the usual company promoter must be of benefit both to the profession and to the industry. If we regard the various propositions that have been placed before the public by engineers of the Hammond type or of the type described by Mr. Hammond, we find that in every case, without exception so far as the writer can remember, the public has had a good run for its money : in other words, the public has made money. And this is not an unnatural result of the special conditions leading to the formation of the enterprises referred to. If a mining engineer knows that his profits can only come from a definite proportion of the whole profits made by the investors, then his first care usually is to take a proposition already a profitable one, and to rely on sounder working methods or larger scale operations for making sufficient profits over the purchase price to recompense the investors and himself. Therefore, for many reasons, if we rigorously exclude the dabbling in shares, we may take it that Mr. Hammond's advice is sound and worthy to be followed. Its limitations arise from other causes: In the first place, the remuneration of the engineer being intimately connected with the amount of profit made by his clients, this limits his consideration of new enterprises. So far as possible he will pay attention only to established ventures, and owners of prospects would find ever-increasing difficulty in obtaining sufficient financial assistance to develop their enterprises to a dividend-paying stage.

Another limitation, possibly of less moment than the former, impresses me individually still more. It is that the engineer who becomes a promoter is perforce so absorbed by the financial considerations of the undertaking that scarcely in any case will the treatment results be found to be nearly so profitable as those of similar enterprises conducted, possibly alongside, under other auspices. It is an extraordinary condition of affairs which one finds hard to realize, as one would have thought that the keener an engineer was to the business possibilities of the venture, the greater the consideration given to the economic questions of the exploitation and beneficiation of the deposits. And thus we are now confronted with the fact that in a recent deal engineered by some of the best mining engineers of the day, the public do not appear to worry about the values in the mine or the price paid—they know the engineers will have looked after that—but whether or not sufficient tube-mills are to be adopted ; in other words, whether the plant is to be an absolutely up-to-date equipment or an imitation of—let us say—the old Esperanza.

I do not wish to labour this point, I have deliberately refrained from quoting examples, but the financial mining engineer who reads these remarks and who looks at the mines he has himself financed, will see that, curiously enough, in his own experience also, whilst he has taken every care of the ore reserves and consequently of the profits to be realized, yet he has been possibly badly hit over his treatment methods, which one after another have given him an infinity of trouble. And so, in conclusion, whilst I am unable to agree with your strictures on Mr. Hammond's advice, which to my mind is both sound and excellent, I feel compelled to add that we must always have the consulting engineer, to take care of the prospects and of the ordinary propositions ; indeed, it would be better if there were a law compelling boards of directors to act in accordance with the advice of duly qualified engineers in arranging the operations of these concerns, and that it would be well if with the financial engineer were especially associated a treatment or metallurgical engineer, whose advice, taken as implicitly as that of the financial engineer, should yield greater profits from the outset instead of after an almost incredible average of say six years waiting. Let the financial engineer quietly sit down and figure out how much more would have been gained if the concentrate at the Treadwell had been cyanided at the time when the Waihi first commenced taking in hand the cyanidation of its specially refractory concentrate, if the Oriental Consolidated had equipped themselves with efficient treatment plant simultaneously with that of the British Concessions, instead of now purchasing the plant at second-hand after the lapse of seven years, if Stratton's had laid down its present installation when the Kalgoorlie mines erected their similar plants, or if the Esperanza had built its new plant at the same date as the New Zealand mines laid down their almost identical equipments. All these mines have made good profits—this in itself is a tribute to the soundness of the position of having a mining engineer as promoter —but they would have made much greater profits had they at the outset treated their tailing and concentrate effectively.

CONSULTING ENGINEER.

London, January 10.

[This interesting letter arrived just after we had gone to press in January—EDITOR.]

Functions of the Engineer.

The Editor:

Sir—In regard to the recent discussion, I am pleased to give you my views, as requested.

The duties and responsibilities, as generally recognized in the City of London, of a consulting mining engineer are those of presenting his reports and recommendations to the board of directors, with whom he deals directly, and only indirectly with shareholders through them, unless especially called upon to do so by the request of the Board.

Given the known financial ability and business acumen of a large number of our city directors acting in conjunction with the consulting engineer, as a colleague and technical adviser, rather than as a subordinate to be called only when difficulties arise, as so often now happens, the engineer's finger would be constantly on the pulse of the enterprise, in a way otherwise impossible.

I am, therefore, in thorough accord with what appears to be the prevailing idea among technical men, and from what I can learn from many directors themselves, that the consulting engineer should have a seat on the Board where he can record any serious divergences of opinion from those of his colleagues in the minute-books of the Company, should any arise. But on the part of the consulting engineer there must be no idea of his dominating in any way the general opinion of the Board. The election of an engineer to a seat on the Board should, I think, be by the directors themselves, thus still making the Board as a whole responsible for the choice of their technical adviser; but once elected he should afterwards retain his seat when coming up for re-election in the usual way, and in his case the holding of the necessary share qualification should be waived.

In regard to the question of commissions: On general principles I agree that an engineer should not accept commissions. I maintain that however honest he may be, as an interested party in any commissions, he must be unconsciously influenced, however much he may fight against it, with the result that the benefit of any doubt arising is given subconsciously on the side of his own interest: for the same reason that a juryman must be a thoroughly disinterested party in the case on which he is called to give his verdict, so, in the case of the sale of property, an engineer should hold a similarly disinterested status.

Neither ought he to delegate his responsibility to another, the reasons for which I think are obvious. On the other hand, as his responsibilities are great his fees should be proportionately large; if not, then he should be compensated in some form or another; this would not be a matter of great difficulty to arrange, but it must be dependent on the subsequent establishment of the truth of his reports.

In any case, if the directors have agreed to pay him a commission it should be made quite public to those who might be asked to subscribe to the enterprise on the strength of his report so that each one may be in a position to judge for himself what value to place upon the opinion.

EDWARD T. MCCARTHY.

London, January 24.

The Editor:

Sir—I have read your leaders on the above. The points involved, and at stake, are of paramount importance both to the mining profession and to the investing public. I see no crime in a mining engineer purchasing shares in a mining company, or receiving a bonus from a company for which he has done good work or performed a special duty, in the interests of that company, and therefore the shareholders. Financial participation is quite another matter, and one which, if universally or generally recognized, is bound to end in disgracing the mining profession and, in the majority of cases, in landing the shareholders in disaster. An engineer cannot conscientiously act for both purchaser and vendor at the same time.

The ideal of most professional men is to become a consultant. To attain this position means many years of hard work spent in the various branches of the profession. Having gained this point and possessing a general knowledge of commercial business, integrity, and those valuable gifts, tact and common sense, he has the essentials for advising the directors on all technical matters, thus ensuring the success of a company which otherwise might prove a failure. If a young engineer, with ambition, starts in life with this in view he is likely to become a credit to his profession and to himself.

The morale of the mining profession cannot be improved by advising its members, and especially its younger members, to aim at financial participation, which, to my mind will, in course of time, lead to a corruption of professional integrity, a premium on 'optimism,' and a vendor's report paid for by the purchaser and subsidized by the vendor.

FRANK MERRICKS.

London, January 21.

Dredging for Gold.

The Editor:

Sir—I am thoroughly in agreement with the remarks appearing in your January issue in regard to gold-dredging costs, with particular reference to the letters of Mr. W. H. Cutten recently published in *The Mining Journal*. Obviously it is not easy to compile a list of gold-dredging costs from any one field, and much less easy to compare the costs in one field with those in another. I agree with you that the costs of gold-dredging must be standardized and defined before any weight can be attached to a discussion of them. I do not think that Mr. Cutten has by any means shown in a convincing way that a dredge of the New Zealand type is more likely to pay dividends than one of the Californian type. In order that his contention may excite serious attention, he should:

A. Enumerate the component factors of the cost of dredging, according to his understanding.

B. In each case cited, give (so far as he is able) the capital expended in equipment, the yardage to be worked, and the approximate life of the property in years.

C. Describe the character of the gravel, with reference to the amount of silicious material, proportion and size of boulders, proportion of foreign matter, such as tree-stumps and sunken logs.

D. State in a more nearly explicit manner for just what kind of ground he would recommend the New Zealand type of dredge, or if he would advise its use for all conditions in all countries where dredging is now practised.

As for the debate between Mr. Cutten and 'Kotuku' regarding California and New Zealand dredging costs, it appears founded on rather empirical hypotheses. Dr. Johnson and Mr. Boswell might have hotly discussed the cost of living among the ancient Assyrians, or two Laplanders might argue as to the best manner of governing the city of Birmingham, yet no profit would result to the contestants, their audience, or the subjects of controversy.

According to the latest information available, it appears that a Canadian Klondike dredge operated for less than 15 cents per yard, working cost. Mr. Cutten might not consider this low, but it is nevertheless a record low cost for dredging in the North, where at least a part of the ground is eternally frozen. I was responsible, some years ago, for the published statement that 80 cents with steam-thawing, or 40 cents without steam-thawing, represented the cost of dredging on Bonanza creek, Klondike. This figure was based on the only dredge operating at that time in the Klondike—a 3 ft. open-connected type of boat that had seen hard service. It dug only 500 cubic yards in 24 hours, and as the staff required to operate it was just as expensive as if it had handled 5000 cu. yd. per day, one explanation of the high cost is apparent. This was in 1904, and Klondike dredging costs have since been reduced by over 50 cents per cubic yard. The main reasons are heavier machinery and larger capacity.

As an illustration of what a California type of dredge does under hard conditions at Cape Nome, Alaska, I take the liberty of quoting from a letter written by W. L. Leland, one of the most successful gold-dredge operators I know, under date March 10, 1909.

"In the three and one-half seasons that we have been running the dredge, the longest single stop, excepting for clean-ups, has been 1 hour and 40 minutes, with an average running time for the entire period exceeding 23 hours out of every 24, while 18 hours running time out of every 24 hours is about the average record for the modern dredges to run while operating in ordinary ground. Considerably more than half of our lost time is caused from delays to the steam part of our machinery. While I do not know, I am told that dredges that are electrically operated, less than one-half of 1% of the lost time is attributable to the motors. Of course, this does not include loss of time or delays that occur at the generating plant. We have practically decided, after burning coal 3½ seasons on the dredge to build an electric generating plant this summer; whether we use water-power or burn oil is a point we have not as yet determined.

"Sometimes we dig in limestone bed-rock for a month at a time, going into it several feet in depth. Our tailing pile shows no wash-gravel whatever on the top, nothing but rough broken-up pure limestone. When we built the dredge I had no idea that we should be able to work the limestone portion of our ground at all. It is self-evident that our dredge would have been wrecked long since, if, in the first place it had not been well designed, well built with good material, and then handled by competent men."

This 5 ft. machine has handled over 3000 cu. yd. per day for the 3½ seasons referred to, although built for a less capacity.

In *The Mining Journal* of January 15, Mr. Cutten (in order to support certain contentions regarding the cost of repairs on dredges) quotes from a manufacturer's catalogue. While not calling in question the accuracy of the statements referred to, I would suggest that professional men would be more easily convinced by facts obtained from actual dredge-operators than by information supplied by machinery-dealers.

The forthcoming Burma installation represents, I believe, the first dredge of the modern California type ordered for the East from an American firm. The Putilof Iron Works of St. Petersburg have supplied three dredges of the California close-connected type for Russian placers, two for the Moscow Timber Co., and one for the Polyakof Platinum Co. These have been running for several years, and although of extremely weak construction, are said to pay a small profit. They cannot be said to be more than a weak imitation of the splendid machines now at work in California. In general, the foreign attempts to install American dredges have been defeated by bad management, or lack of money, or both. At best, they have been half-hearted, and no apologies or explanations need be made on the subject. When the time is ripe, dredges of the California type—heavy and of large capacity—will doubtless be installed abroad. They will pay dividends, where it is possible for any dredge to pay dividends, and I firmly believe that the electrical dredges of the close-connected bucket type will in any given case pay larger dividends than will steam-driven dredges with buckets of open-connected type. I also believe that dredges of heavy and massive construction are more suitable for handling auriferous gravel than are those of light weight and small engine-capacity. Mr. Cutten will admit that it is more economical to use a sledge-hammer to drive a tack, than to attempt to use a tack-hammer to drive a spike.

It is a fact that American dredge-manufacturers such as the Western Engineering and Construction Company, the Yuba Construction Company, the Marion Steam Shovel Company, the Bucyrus Company, the New York Engineering Company, and the Link Belt Machinery Company, have developed their dredges, assisted by conferences with the owners and operators, largely within the past five years. Any one of these firms can point to successful dredges of their manufacture operating today, but any one of them would admit that they have made mistakes in the past. It is significant that all these firms working in competition in California have developed a type of dredge from which there is little individual variation. It should also be remarked that this type has been installed in Colorado, in Montana, in Alaska, and in the Yukon territory, and that all the dredges are reported successful, not by manufacturers, but by the owners.

Unquestionably European manufacturers both in England and on the Continent can build dredges of the California type. Whether they can duplicate the California installations at a lower price than the American dredge-manufacturers remains to be seen.

That the demand for heavy dredges of the California type will increase cannot be doubted, and European manufacturers will naturally be called upon to bid.

One important fact has perhaps not been sufficiently emphasized. Ground that can be profitably dredged for gold does not vary greatly from a certain physical type in any part of the world. The massive electric dredge as built today renders possible the dredging of ground which less than ten years ago was considered unexploitable by dredging. To say that a large heavy dredge with a capacity of 5000 cu. yd. per day in heavy ground cannot handle light gravel in greater amount and with greater profit, values being the same, is a statement that requires proving. Until the opportunity is afforded for a competitive test between the European open-connected dredge and the California dredge in the same ground discussion of the subject is premature.

C. W. PURINGTON.

London, January 24.

The Malm Dry Chlorine Process.

The Editor:

Sir—The remarks in your issue of December relating to the Malm dry chlorine process were not founded on the latest knowledge available on the subject. Granted that the process as conducted by Swinburne and Ashcroft some years ago was not commercially successful, it does not follow that better results should not now be obtained. One of the great drawbacks in the old days was the great cost of current, which accounts for 95% of the whole cost of electrolyzing zinc chloride. Things have changed since then, and current costs only one tenth of what it used to. In many districts in Colorado the cost nowadays is $50 or less per horse-power-year. Under these altered circumstances you should recognize the fact that the electrolysis of zinc is not as expensive as it was in former days. I would add that I am personally familiar with the Swinburne-Ashcroft process and with that used by

Brunner, Mond & Co., having visited Europe for the express purpose of studying them. I protest also against your remark that the "displacement of sulphur by chlorine is not an easy reaction to work in practice." I don't know what the exact meaning of these words is intended to be, but I presume it means that it is difficult to cause the displacement of sulphur by chlorine at a commercial profit. As a matter of fact, the reaction is one of the most active, positive, and satisfactory chemical reactions known in metallurgy, and not only is it an easy reaction to work, but steps have to be taken to retard it. However, it is true that the process must be under the direction of a metallurgist of at least ordinary ability.

JOHN L. MALM.

Denver, January 8.

Precipitation of Gold and Silver from Cyanide Solutions.

The Editor:

Sir—I notice in your issue of January an article entitled 'Extractor-Box,' which refers to a description in the *South African Mining Journal* of a new extractor-box designed by Messrs. Lloyd and Rand in which zinc clippings are used instead of zinc shavings.

I wish to confirm all that these gentlemen say in reference to the efficiency of zinc clippings. When the cyanide process was installed in the Caveira mine in December 1907 oblong clippings of about one square inch area were used and have been used since without interruption.

The precipitation of the metals from the cyanide solution is as near perfection as possible. Ordinary extractor-boxes are used but because of the efficient action of the zinc on cyanide solutions the layer of clippings in each compartment need not be more than 3 in. deep. The collection of the bullion precipitate from the extractor-boxes is carried out in the usual fashion, but the precipitate is so dense that filter-pressing is unnecessary, and it contains so little base metal that the use of acid is unnecessary and, in fact, is discarded. The dry precipitate is easily fused with a minimum of dusting and yields about 85% of its weight of bullion about 900 fine. The amount of zinc consumed is three times the weight of the bullion produced.

While I would hardly dignify the use of zinc clippings against zinc shavings as an important invention, the work of Messrs. Lloyd and Rand and that done by me adds point to your remark: "The simultaneous invention of metallurgical processes by entirely independent investigators is a recurring phenomenon of psychological and industrial interest."

JOHN S. MACARTHUR.

Glasgow, February 1.

Counsels of Imperfection.

The Editor:

Sir—I am glad indeed to see that you are so ready to fight for the professional integrity of the mining engineer.

I am entirely with you and hold that the advice to mining students to make promoting the aim and object of their professional life is wrong and as you well say, will "vitiate the entire purpose of scientific teaching." Did I imagine for one moment that such ideas were countenanced at the Royal School of Mines here I would think very seriously as to the advisability of allowing my son to remain there as a student.

This question of the correctness of giving such advice to mining students seems to be given minor consideration by Mr. H. C. Hoover in his letter published in your last month's magazine, while he gives prominence to other views which are somewhat beside the point. I take it that no one does object to any mining engineer investing money in mining shares should he desire so to do, but surely the purchase and sale of shares in mining companies by a mining engineer who has no official connection with the company whose shares he is dealing in, is one thing; and the same operation by an employee of the company is another matter altogether.

My contention is that no employee of any mining company should be permitted to deal in the shares of the company employing him. By 'dealing' I mean a fairly frequent buying and selling of shares according to their rise or fall on the market. I agree, however, with Mr. Hoover that many mining companies would be better managed were one of the directors a trained mining engineer; but then he ought never to hold any subordinate position in that company. I am given to understand that such dual positions have been known to exist, but to me it seems an anomalous position for any man to occupy.

All employees of any mining company, not excluding the consulting engineer, manager, etc., are surely the servants of the board of directors and no man should occupy the position of both master and servant in the same company.

ALEXANDER HILL.

London, February 2.

MINERAL RESOURCES OF MANCHURIA

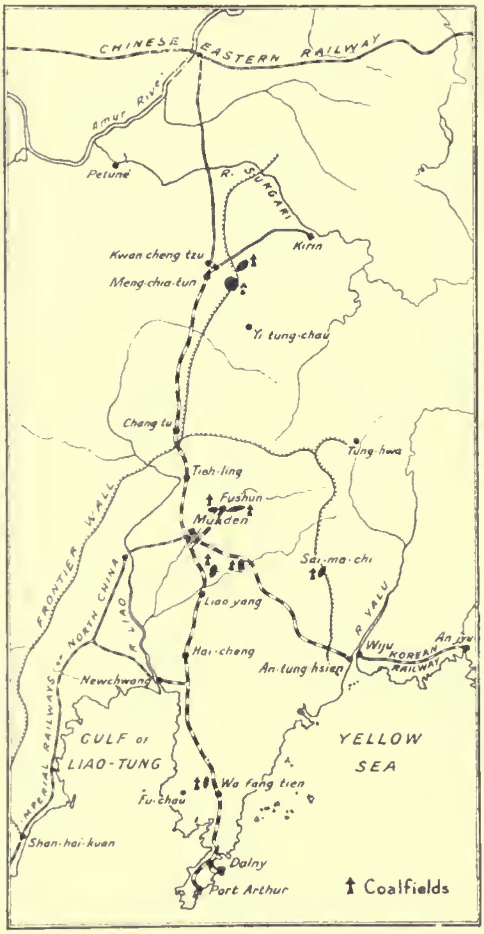
By THOMAS T. READ

IN an earlier article I have described the coal resources of Manchuria. This is the most important of the mineral wealth of this large area, so rich in future possibilities. There are others however, some of which are important even at present, while others derive interest from their promise for the future.

Next in importance to coal is gold. The exact amount produced it is impossible to estimate; all the larger workings are Government property, and their output, as well as that of the numerous individuals who carry on work on a smaller scale, finds its way into the currents of trade through channels too devious to trace or to measure. An aid to forming a general idea is, however, found in the fact that China exports practically all its produce of gold, as none of it is used in coinage, and its employment in the industrial arts is small, compared with Western countries. We shall not be far in error, then, if we assume that the annual export of gold in the form of bars and dust is approximately the same as the annual production. In 1908 the amount of gold thus exported was £1,125,000, and as 1908 was a year in which the price of silver was low, thus favouring the export of gold, it is not likely that the annual production has ever been much greater. Out of this total it will probably be safe to credit three-fourths to Manchuria, for though gold is produced in numerous other localities in China, the proportion of the latter is undoubtedly small. But a further element of doubt is introduced by the fact that a considerable quantity of gold produced in Siberia used to be smuggled across the boundary into China, as the miners in Siberia were required to sell their product to the Russian government at very low prices. It is generally believed that this illicit traffic has now largely ceased, because the conditions have changed. On the whole, on a rough approximation, we may credit Manchuria with an annual production of some £700,000.

This gold occurs both in the form of veins and of placers, which have been derived from the veins; but most of the production comes from the alluvial deposits. These may be divided into two groups: those along the southern tributaries of the Amur, and those about the headwaters of the Sungari river, in Kirin and Fengtien provinces. The former is the more important of these deposits.

Gravel containing gold is washed at many localities in the Amur region; the best known are Mo-ho, in the extreme west of Hei-lung-chiang province, and T'ai-ping-k'ou, in the extreme east. Along the courses of the tributary streams are many others. According to Hosie the gold on the upper reaches of the Amur exists in a conglomerate; if this be the case it is probably only washed where the conglomerate is disintegrated. All the larger workings are, as previously mentioned, carried on under Government auspices, and frequently notices appear in the native Press stating that the Government has notified the



Map of Manchuria.

officials in charge that the profits from the workings are not sufficiently large and that they must do better; which is a polite way of intimating that the officials in charge are retaining too large a portion for their own private purse. It may be comprehended from this what are the difficulties in the way of ascertaining the amount produced.

The gold production of the more southern area, while important, is not nearly so great as that along the Amur, and a much larger part of it is in the hands of individuals. The director of the Mining Bureau in Fengtien province has compiled a list of some 10 productive localities in his province, and of over 40 places where gold is known to occur, but is not now worked. There are many others in Kirin province.

The gold-bearing veins throughout this area are, so far as known, narrow and inclined to be pockety, so that it does not seem probable that they would prove profitable when worked on a large scale. Generally speaking, the same prophecy may be ventured in regard to the placers, for Chinese labour is so cheap and efficient that it would be remarkable if cheaper working and closer saving could be made by the introduction of dredges, for example. I may again quote the old story of the gold mine in Shantung where the near-by farmers used to buy the tailing from the mill and carry this residue home to re-grind and pan it during the winter, when they were not busy in their fields. But the matter is not one of much interest to foreign companies, as it is extremely unlikely that mining concessions will be granted to any such, and only old residents of the East who are thoroughly familiar with the conditions would care to risk their money in a company controlled by Chinese and operated according to their mysterious business methods.

This question of gold production has a further interest in its bearing on the problem of providing a uniform currency system for the Empire; a problem with which the Government has wrestled half-heartedly for some years. China is not an important producer of either gold or silver. The silver supply for its present currency — it cannot be termed a system—has been provided by the export of gold and merchandise. To create a gold reserve for a gold standard would require a resale of this silver, the larger part of which was bought when silver commanded a higher price than it now does. Add to this the fact that the present low price of silver is a powerful stimulus to the export trade of the Empire, for an ounce of silver will buy nearly as much labour as it ever did and the ounce of silver can be bought with a considerably less quantity of merchandise than it formerly could, and it appears that China has little to gain and much to lose by changing to a gold standard, for the present at least. The trend of events now seems to be toward providing a uniform silver currency based on a dollar of uniform fineness and weight. But as long as the minting of the currency is left in the hands of the provincial authorities it is idle to expect even this much to be accomplished without delay.

The iron resources of Manchuria are of little present importance and it is rather a question how much promise they possess for the future. The only locality about which there is any definite information is T'ieh-ling, a short distance north of Mukden on the South Manchurian railroad. Here there was a rather considerable native industry, which now languishes in the face of the increasing import of foreign steel and old iron. As I have pointed out elsewhere,[*] it is impossible for the native industry, in spite of the exceedingly low cost of labour, to flourish where imported iron can be easily laid down, as the native product is of such inferior quality. What the possibilities of developing an iron and steel industry with modern methods are no one can say until an adequate survey of the area has been made. The Japanese have made a reconnaissance geological survey of the region south of Mukden, but the entire northern part is still unexplored. Judging from what I saw from the train in travelling along the Chinese Eastern railway, the north offers enough promise to justify careful exploration.

Copper, silver, lead, and antimony may be grouped together and dismissed with the statement that although they are known to occur they are not now worked. There is little definite information available regarding these metals. In the adjoining northern part of Chili province lead - silver deposits occur and at various times in the last thirty years attempts have been made to work them by modern methods, but without success as yet, as the deposits are too narrow and irregular for profitable exploitation. It seems to me that it is at least as probable that the Manchurian deposits will prove similar as that they will prove to be of great richness.

Platinum is reported to exist in a copper deposit not now worked. Asbestos is found in more than one place, but there are no data as to the quality. Jade and carnelian occur, and as they are in demand in Chinese art,

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they are worked on a small scale, and a small annual production is reported.

It will be seen from the foregoing that the chief mining interest in Manchuria centres about coal and gold. Coal is important both as a source of present profit and as a factor in international questions. Gold is extremely important to China as a commodity to exchange for the silver she needs, but the development of this resource is most likely to be advanced by improving and extending the native methods. The other mineral deposits just now offer little beyond the lure of the unknown; they may prove of much value, but one is rather inclined to adopt the attitude of the man from Missouri. As far as possible the Chinese will reserve these potentialities for themselves: they have learned the proverb: *Timeo Danaos et dona ferentes.*

Copper in Russia.—According to a recent consular report, the production of copper in Russia has been 10,306 tons in 1906; 14,554 tons in 1907; and 16,591 tons in 1908. Of the metal produced in 1908, not less than 8429 tons came from the Ural, 4780 from the Caucasus, 2416 tons from Siberia and the Kirghiz steppes, and all other districts yielded 966 tons. In the same year the consumption of copper in Russia was 16,478 tons of domestic production and 4855 tons of imported metal. The prices at Moscow during 1908 ranged from 27 to 34s. per pood of 36 pounds.

Electrolytic Deposition of Zinc.—In United States patent 935,250, V. Engelhardt and Max Huth describe an improved method of depositing zinc electrolytically from solutions of zinc sulphate. This patent has been assigned to Siemens & Halske of Berlin. In the ordinary way of depositing zinc from sulphate, the zinc begins to re-dissolve directly the amount of free sulphuric acid in the electrolyte reaches 10% of the solution. It is supposed by the inventors that this action is caused by the presence of even small quantities of impurities derived from the anode, whether the latter consists of lead, platinum, or carbon. There is a considerable advantage in being able to use a solution strong in sulphuric acid because the zinc deposited from such a solution is pure, crystalline, and free from oxide. The inventors have found that, by using a pure and compact lead peroxide mounted on a non-conductor, the zinc is not re-dissolved when the acid content becomes high.

KOREANS WASHING GOLD-BEARING GRAVEL.

SKETCHING

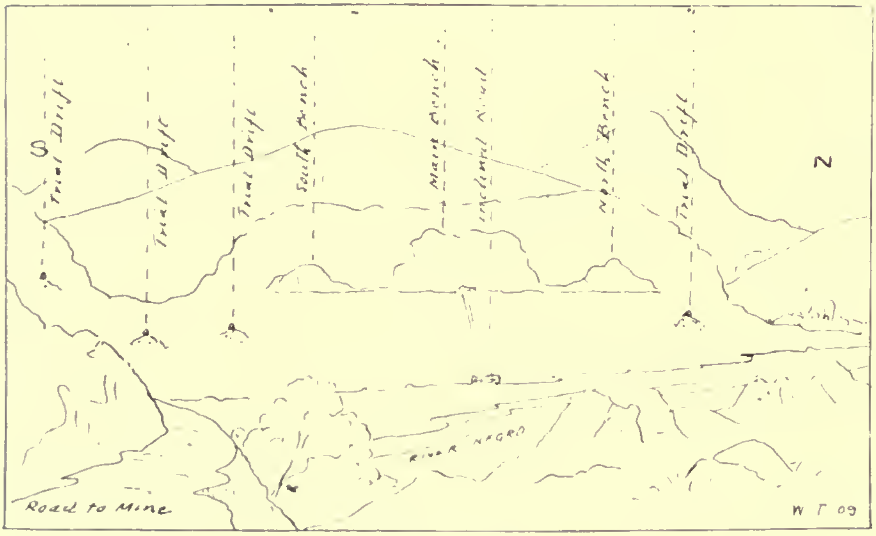
By W. TRURAN

IN these days when the mining engineer has to be a man of many parts, his calling obliging him to give attention to subjects that formerly went unconsidered, it is important that nothing should be omitted in any way likely to bring him nearer to that state of perfect efficiency demanded by modern industry. With this end in view, and in the hope that it may be of service to many of my fellow engineers, I have thought it advisable to impress upon them the value of sketching as applied to mining. Sketching considered as a branch of Art requires, I grant, a natural power that must be innate, but as the object of this article is to consider sketching from an engineering, not from an artist's point of view, I shall ignore that side of the question altogether. There must be many engineers, who, with a little instruction and advice, could make use of sketching in their work to the advantage of themselves and of their clients. The object of such sketching should not be to produce a picture fit to adorn the walls of a drawing-room, but to reproduce on paper as a whole and in detail, the situation, surroundings, and various points of greatest importance connected with a mining property.

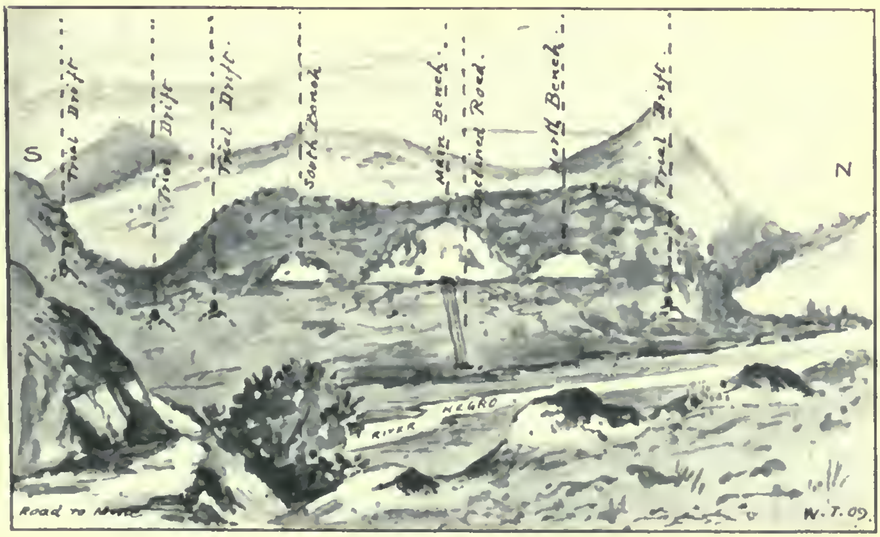
Photography, which is now practised by many engineers, cannot, in my opinion, compare with sketching. Photography involves the carrying of a camera, re-fills of plates or films and developing, trouble with Customs officials, and the risk of failure. On the other hand in sketching there is no risk of failure through exposure, the necessary outfit is practically nil, and above all the engineer can reproduce exactly what he requires, no more and no less. He can emphasize salient points, sweep aside hills, trees, or any other obstacle that happens to interfere with a clear illustration.

With regard to the method of procedure: My plan of working has usually been to make a pencil outline on the spot; this often has to be done rapidly, filling in the most important points, and leaving the shading until later. In order to carry out this work, all that is needed is a sketching-block, pencil, and rubber. The cost is negligible and the trouble of carrying such an outfit is not worth mention. The various points to which it is desired to draw attention are marked and named (as on the annexed example), and on my return from the visit, or whenever convenient, I make the complete sketch either in sepia or Payne's grey, using the rough sketch made on the spot as a guide only. This part of the work may appear difficult to the tyro, as it necessitates a varied experience in the study of light and shade, and the general appearance of objects, which only practice can impress upon the human brain. If conditions are favourable, the sketch can, with advantage, be filled in and completed on the spot. I am, however, inclined to think, that until the engineer has had a fair amount of practice, he will do well to content himself with outline sketches. The outline should be clearly drawn, the greatest attention being devoted to relative distances, heights, widths, etc., as these are the points of most importance. Also the correct position of orebodies, outcrops, workings, etc., should be carefully pencilled. I think it will help the beginner to use the sides of his rectangular sketching block as an aid to the correct placing of the various points in his sketch. He must first decide how much he wishes to include in his sketch, as on this factor will depend the scale of his drawing. Having once decided this point, by holding his block between the line of sight and the subject until that portion of the view that he wishes to reproduce is enclosed in the rectangle of his sketching-block, he can note the points where the lines of his subject intersect the vertical and horizontal lines. By this means he will be enabled to ensure the correct relative distance apart from the objects in the sketch. Once a starting line has been put in, all other lines can be produced in their correct proportion, by comparison. If objects such as trees, rocks, etc., shut out important features, they should be omitted.

In producing a general view of a property, it is well to make the sketch at some distance, as by this means, more can be brought in: roads, streams, etc., can be included. Landmarks, such as trees or rocks, are of the greatest assistance in determining the relative position of objects. The whole secret of the work is comparison and the engineer must remember that the main object is not the production of a beautiful picture, but an accurate representation such as will be of service to him and others.



Rough Sketch in Outline.



Finished Sketch.

EXAMPLES OF SKETCHING.

METALLURGICAL METHODS AT PACHUCA, MEXICO

By JOHN M. NICOL

THIS famous mining district in the State of Hidalgo, covers an area about 21 miles long and 15 miles wide, embracing Pachuca proper, Real del Monte, Chico, and other smaller settlements. The main lode-system strikes east and west, though at Real del Monte there is also a north and south vein-system. The mines are scattered over a range of hills, which form the north-eastern boundary of the great valley of Mexico. The highest points of the range reach an altitude of a little over 11,000 ft., the city of Pachuca itself standing at an altitude of 8000 ft., or about 600 ft. higher than the city of Mexico, which is only 60 miles distant. The southern slope of the mountains drains into the great valley of Mexico and is dry, barren, and desolate. The northern slope, including the district of Real del Monte, has a pleasant climate and a fertile soil.

Mining operations were commenced at Pachuca soon after the Spanish conquest; from 1557 until the end of the eighteenth century the mines were worked steadily, the only interruptions being due to the lack of quicksilver, which was then a crown monopoly. The mines of Real del Monte are among the most famous in the country and were first worked on a large scale by a Basque miner and merchant named Pedro José Romero de Terreros, who was made Count of Regla. The family of the Condes de Regla held these mines until the Revolution, and shortly afterward their representative transferred the property to an English company, formed in London with the assistance of John Taylor. This company began to operate during the troublous days of the war for independence. They worked under difficulties, invested great sums of money, and wasted still more, of which the remains of houses, parks, and gardens, in the English style, still survive as reminders of a by-gone era.

In 1848 this company, being in hopeless difficulties, was dissolved, leaving a total outstanding debt of about £1,000,000 sterling. The property was bought by a Mexican company, which, while working on a more economical basis, had also the luck almost immediately to strike a bonanza. In 1906 the United States Refining, Smelting & Mining Co., of Boston, obtained control by purchasing a majority of the stock, and this corporation is now the largest operator in the State of Hidalgo. In Pachuca the company owns 2328 acres of mining land; in Real del Monte, 4210 acres; and in ranch property, over 25,000 acres. The present management has paid over $2,000,000 in dividends since it took control of affairs, besides making important changes in mining and metallurgical methods.

On the south slope of the mountains facing the great plain of Mexico is another vein-system, which was unknown and unworked in the early days. This includes the Santa Gertrudis group, the La Blanca, the Barron, and the Dos Carlos group. The Santa Gertrudis was 'denounced' or located in 1874, and since 1877 has never missed paying a dividend. From an engineering point of view it seems a pity that the entire vein-system of the locality could not be consolidated under one company and one management, for the topography is such that the output of the whole group could easily be delivered to one central mill, and the drainage and probably the greater part of the ore could be handled through one main shaft. The Santa Gertrudis until lately was controlled by a Mexican company, which owned the claims of Potosi, Santa Gertrudis, Amistad Concordia, Alianza, San Patricia, Nueva Santa Gertrudis, El Refugio, and Virginia. The English company now also owns the Guadalupe reduction works, at the lower end of the town of Pachuca and about two miles distant from the mines. Ore is transported over the lines of an independent tramway company or is hauled in wagons. At the mill, and on the old patio, the company is erecting a cyanide plant.

The Barron mine covers a lower portion of an extension of the Santa Gertrudis vein-system and the ore is hauled to the Loreto mill, which, with the mine, is owned by the Real del Monte Co. The La Blanca appears in part to be the same vein, but at its eastern extremity it curves to the north and only at great depth, say 5000 or 6000 ft., it would dip under the southeastern end of the Barron or the northern end of the Velazquez de Leon.

The Santa Gertrudis, Le Blanca, Barron. and their adjoining claims are practically the only developed mines on this particular vein-system, which, although it forms part of the district of Pachuca, is really independent of the lodes of Pachuca or those of Real del Monte.

CHICO, IN THE PACHUCA DISTRICT.

The geological formation of the Pachuca district is everywhere eruptive, with the exception of some sedimentary areas to the extreme northeast. These rocks have been classed by the Instituto Geologico de Mexico, as of Tertiary age. Apparently the detritus derived from the denudation of the volcanoes has been removed by erosion, for the veins occur in the massive rocks forming the base of the volcanic structure. Andesite predominates; to the south-east is rhyolite; and on the eastern slope of the mountains there are later flows of basalt.

The characteristic product of the district is a silicious silver ore carrying a little gold, the average proportion being about 5 grammes of gold to one kilogramme of silver. The latter occurs chiefly as a black sulphide, though there is a noteworthy admixture of galena, as well as iron pyrite, and occasional zinc-blende. An important constituent is manganese; in the oxidized zone it occurs as a black oxide and in the lower levels as the silicate (rhodonite), together with a relatively small amount of copper. These 'cyanicides' are removed by successive concentration, as will appear later.

The metallurgical method in vogue locally for over a hundred years has been the Patio process, the last examples of which will soon disappear from Pachuca. In later days the richest ores were sent direct to the smelters; and a few plants were installed using the Boss continuous system of pan-amalgamation. But in the last few years there has been a complete metallurgical revolution; all the largest existing mills, and those to be erected, are based upon a step-reduction process consisting of crushing in cyanide solution without amalgamation, followed by concentration, all-sliming of the tailing in tube-mills, then cyanidation with agitation, and final treatment in vacuum filters.

A description of three of the leading mills, all based upon the same general principles, but varying widely in their mechanical arrangements, will be of special interest at this time.

The San Rafael mill* owned by the company known as the San Rafael y Anexas is an excellent example of a plant equipped with the so-called Pachuca tanks. The ore from the mine, and especially from a large low-grade dump accumulated in former years, is first roughly hand-sorted; the waste is picked out and the pieces too large for the crusher are broken with a sledge-hammer. The general arrangement of the sorting-floor and bins is a survival from the early days, and appears to involve a good deal of hand-labour. The crushers and crusher-bins are entirely separate from the mill; from the bins the ore is taken in hand-cars to the mill, which contains 80 stamps; 40 of these weigh 850 lb., and were supplied by Krupp; the other 40 weigh 1250 lb., and were built by Allis-Chalmers; of the latter, 20 have only just been erected. Before the last addition was made the monthly average was 7933 dry metric tons of 2204 lb.; and the saving in concentrate was 63·5 tons per month. I was unable to obtain separate statistics for the duty obtained from the stamps of different weight, but the average of the whole battery for the last week was 5·472 metric tons. The mortars are of the usual single-discharge wet-crushing type and the screens used are Tyler's 'Toncap,' using 12 mesh on the light stamps and 16 mesh on the heavy.

The battery-pulp goes direct to 16 Wilfley tables using a No. 3 running gear, and a No. 5 deck. The idea is not to concentrate closely, but to cut out a clean high-grade product that will contain the bulk of the cyanicides. The coarse tailing from the Wilfleys goes straight to four Dorr classifiers of the latest type; the Wilfleys are also used as classifiers by cutting out the fine slime, which is sent direct to Dorr slime-thickeners. The overflow from the classifiers, adjusted to discharge everything below 200 mesh, goes also direct to the slime-thickeners; while the coarse sand from the classifiers passes to the tube-mills. Of these there are five, each 4 ft. by 20 ft., made by Krupp, and fitted with El Oro liners. French black pebbles are used for grinding, and the liners are cast locally. The overflow from the tube-mills is returned by Frenier spiral sand-pumps to the classifiers.

There are 5 Dorr thickeners, two 10 ft. deep by 24 ft. diam., and three of 10 by 20 ft., the larger size having a capacity of 100 tons of pulp in 24 hours. From the thickeners the clear overflow is pumped to the storage-vat, whence it goes to the stamp-mill, the crushing being done in a 0·25 to 0·27% KCy solution. The thickened pulp passes by gravity direct to the Pachuca tanks, of which there are ten, each 45 ft. high by 15 ft. diam. The 'tanks' were supplied by Grothe & Carter, of Mexico City, who control the Mexican patents. These 'tanks' handle the whole product of the mill or about 400 tons per day. Agitation by compressed air is performed continuously for 36 hours; the pulp is then allowed to settle from 15 to 24 hours, according to the time available and the demand

*I have to acknowledge the courtesy shown to me by Edmund Girault, the managing director, and by N. W. Pendergast, the superintendent of the mill.

for tanks, since the longer time of settling improves the extraction. After settling, the tanks are blown out to the filter, without decantation. A Moore vacuum-filter is used having four baskets each of 40 leaves. Two extra baskets bring the total to 240 leaves. The first solution filtered is, of course, the richest, and the pulp is agitated by a jet of air while the cake is forming. A $\frac{3}{4}$-in. cake is formed in about 12 minutes and the maximum or $1\frac{1}{2}$-in. cake in 25 minutes. The cake is given a wash in the weak solution in another compartment, and subsequently in water. The basket is then Moore filter, so as to run five baskets. This will bring the total capacity of the mill up to over 400 tons per day. In the precipitation-room there are 20 sheet-iron zinc-boxes, each with 5 compartments. Zinc shaving is used. The boxes drain into two settling-vats, from which the precipitate is pumped by a triple pump to a small filter-press made by T. Shriven & Co. The precipitate is then dried and, after mixing with crushed bottle-glass and soda flux, is melted in crucibles in a coke-furnace, yielding bars of bullion weighing from 32 to 33 kilogrammes. The melting-floor is immediately

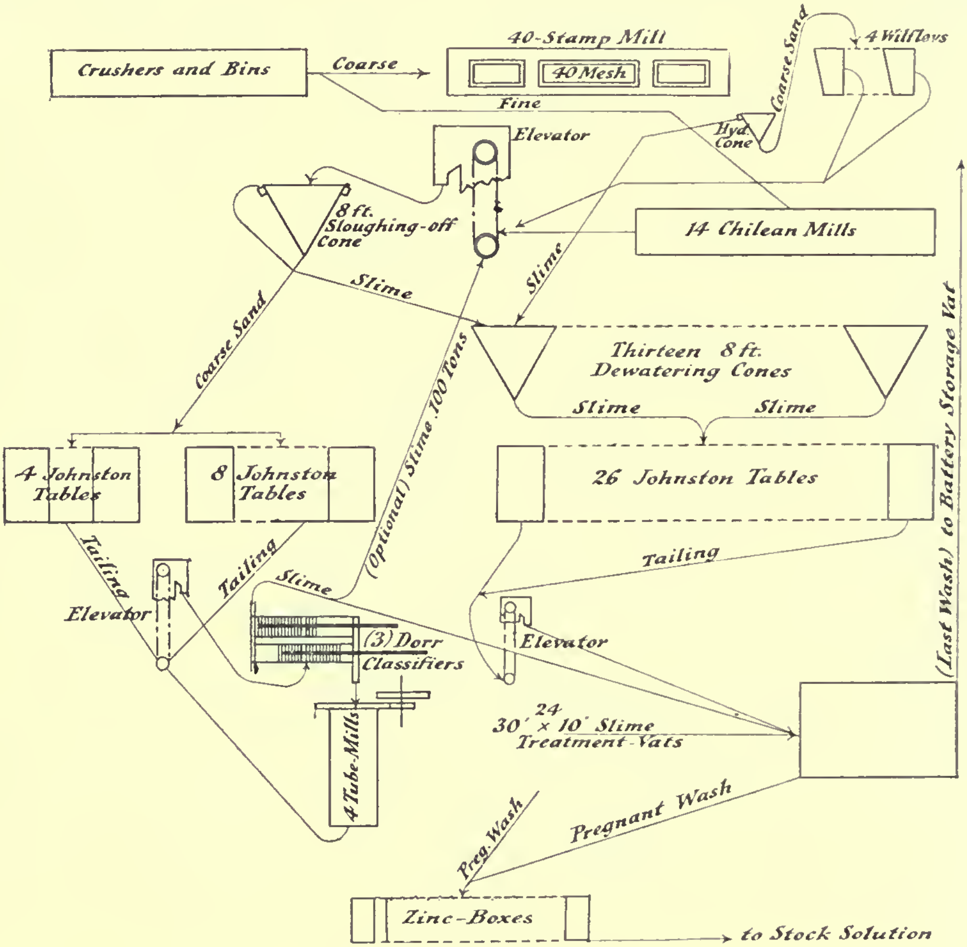
THE HACIENDA DE SAN FRANCISCO, PACHUCA.
Using Pachuca Tanks, Air-Agitation, and Butters Filters.

hoisted to be sampled; this is done by a native boy, who, with a special spoon, scrapes a sample off each leaf from bottom to top. These samples are taken dry. The basket is then lowered into the tank and the cake is blown off under water and discharged. The rich solution is pumped back to the zinc-boxes by Aldrich triplex pumps, the ball-valves of which were a source of endless trouble until plain straight valves were inserted in their place. Since then the pumps have given perfect satisfaction. Two more Pachuca tanks are to be added, and also an additional tank for the below the zinc-box room, and I must frankly state that the arrangements for handling the crucibles, and the furnaces generally, seemed rather crude and not at all in keeping with the other up-to-date appliances in the mill.

No automatic sampling of any kind is in vogue in this mill, the heading being sampled by taking a shovelful of ore off every car. This is subsequently reduced and assayed in the laboratory. The concentrate, after drying, is heaped and mixed on a cement floor, and sacks are carefully filled from opposite quarters until only two quarters of the heap are left; and then follows an elaborate system of hand-sampling and quartering. The concentrate is shipped to the smelters.

The Real del Monte owns two principal mills, the Loreto and the Guerrero. The accompanying flow-sheets will aid the description. The Loreto was originally an extensive *patio* belonging to the old company; it is a have been developed without such upsetting as would result to the automatic arrangements of a new plant. To Mr. Sherrod, the general superintendent, I owe the information that follows.

At the Loreto mill the ores treated are not generally so hard as those delivered at the Guerrero, and in making any comparison of



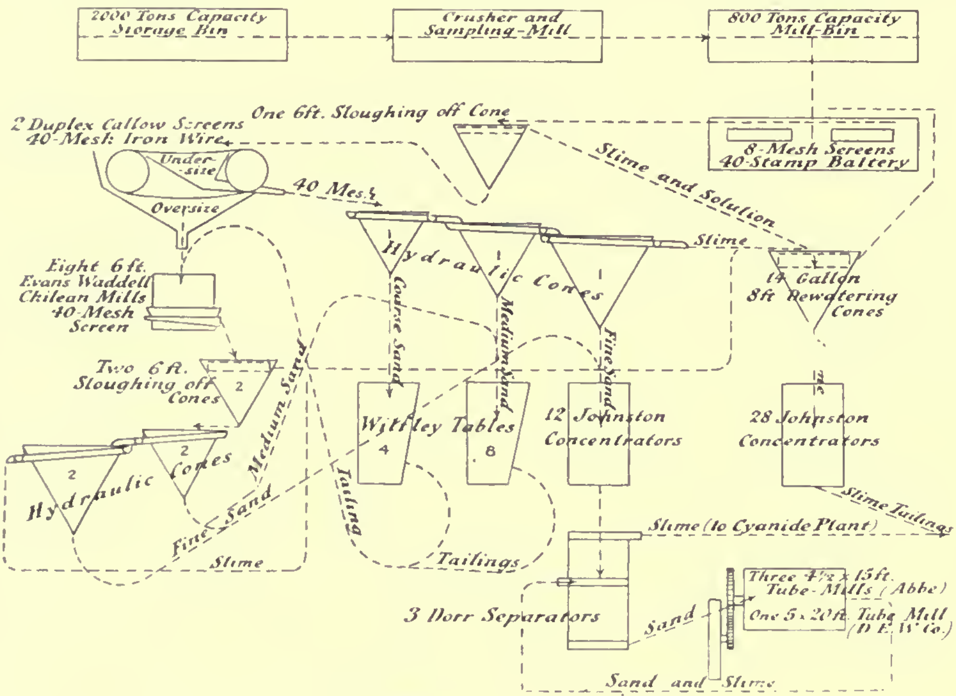
FLOW-SHEET OF LORETO MILL.

mill that has gradually grown as experience and the necessities of the time demanded, and a great deal of the present arrangement is therefore dependent upon former plans and construction work; but while it cannot be considered a modern mill, it is an excellent example of intelligent adaptation. Owing to the fact that the Loreto is directly under the eye of the chief mill-superintendent, and receives a variety of ores, and has plenty of room, the mill has been used as a kind of experiment station, and new ideas and improved methods crushing efficiency, this factor must be taken into account. It will also be noticed that the crushing efficiency of the Chilean mills, for grinding to slime, appears to be higher than that of the tube-mills, but it must be remembered that the under-size of the grizzleys goes direct to the Chilean mills, and the hardest and coarsest ore goes to the stamps. Moreover, the tube-mills have to grind the most resistant particles of the ore, which have so far escaped comminution by all other types of crushers.

The flow-sheet of the Loreto mill is self-explanatory. The ore from the first set of bins passes to jaw-crushers and is broken to about 2 in. ring. It is hand-trammed to a second set of bins. The grizzley over-size, which is the hardest ore, goes to 40 stamps, each weighing 1050 lb., in single-discharge mortars fitted with Tyler's 40-mesh wire-screen, using No. 35 wire. When running the horse-power used is 2·4 per stamp, and the duty is 2·42 metric tons. The under-size from the grizzleys goes direct to 14 Chilean mills, each of which crushes 24 metric tons per day, consuming about 20 h.p., when crushing through 40-mesh.

ft. tube-mill of the Denver Engineering Works with El Oro lining consumes 51 h.p., grinding 0·49 kilo. dry per h.p. min., to the same size.

On examining the flow-sheet it will be noted that hydraulic classification and dewatering has been carried to a fine point and great care has been taken to effect concentration by a step process with a system as thorough and complete as possible. The slimed pulp is taken from the classifiers, adjusted to 200-mesh overflow, and passes to 24 vats each 10 ft. deep and 30 ft. diam., equipped with mechanical agitation and with one air-jet for each vat. An average of 59·94 tons is treated, allowing 72



FLOW-SHEET OF GUERRERO MILL.

To the tube-mills is delivered only the material that has passed a 40-mesh screen, so that the average feed contains at least 10% of 200-mesh. The proportion of solid to fluid is about 65%. Everything is slimed to 200-mesh, the coarse being returned for re-grinding. A great number of efficiency-tests of tube-mills have been made at the Loreto, under varying conditions. The results can be summarized as follows: The 4 by 18 ft. Krupp mill with El Oro lining consumes 32 h.p., grinding 0·6 kilo. dry per horse-power-minute to 200-mesh. The 4½ by 15 ft. Abbe tube-mill with silex lining consumes 28 h.p., grinding 0·54 kilo. dry per h.p. min., also to 200-mesh. The 5 by 20

hours for agitation. The following material is used, in kilogrammes per ton of ore: 3·29 lime, 1·35 sodium cyanide, and 0·17 sodium acetate.

After agitation, the pulp is allowed to settle and the solutions are decanted before clarification in other vats. A complete system of agitation by centrifugal pumps was tried, but it was abandoned, as it was found to be more costly than mechanical agitation, the wear on the pumps and the cost of maintenance being excessive. One small jet supplies all the air necessary for oxidization.

After decantation the pulp is sluiced out of the vats and is pumped to the stock-vat, and from there passes to the filter-plant, which is of the Butters type. The following data represents one month's operations: 10,428 metric tons of dry slime were treated in the filter; 47,344 tons of solution passed through the zinc-boxes, using 7162 kilo. of zinc. The filter, when operating with wash-water only, treated 408 kilo. slime per leaf per cycle in 1·89 hours; and the average of each cycle was 1 hour 53 minutes.

It is found, throughout the Pachuca district, that a great deal of calcium carbonate forms on the filter-cloth, of both the Moore and the Butters machines, so that the leaves after a short time become completely choked. To remove this lime the leaves after a few cycles are immersed in a bath of dilute hydrochloric acid; this forms an item of expense in the cost of operating filters; at the Loreto mill the amount consumed averages 50 c.c. of acid per leaf per cycle.

At the Loreto the sampling methods have not yet been perfected, but Mr. Sherrod is fully alive to the advantages of automatic and mechanical sampling and he has made a number of interesting experiments with regard to the errors that arise from careless sampling. In consequence, a system of automatic sampling has been established in the Guerrero mill. As an example, it will be found that when a car is loaded from the chute, the richest particles of ore being the heaviest, they slide on the bottom of the chute and naturally tend to enrich the side of the car nearest to the chute and on the top; hence, if a boy takes a random shovelful it depends from which part of the car he takes it. It was found in sampling the heading that if the shovelful was always taken from the farther end of the car, the theoretical extraction rose to over 100%; and if it was taken from the top of the loading end of the car a difference of 40% was exhibited. In sampling Butters filter-leaves with a spoon, a liability to error arises from the fact that the sample is 'washed' as it is drawn up through the vat. Mr. Sherrod intends to sample the tailing of the filter automatically by discharging the cake into a receiving-vat, where it can be broken up and reduced to pulpy consistency once more, and run out through a sluice with the waste-water from the mill, so that a portion of all the stream can be automatically sampled all the time.

The Guerrero plant had only been started when the new management took charge; it has not suffered so much re-modelling as the Loreto, and is therefore more nearly a complete design. The ore is received from different shafts, whence it is conveyed to the mill by an aerial tramway and by a railroad. It is all dumped into a storage-bin of 2000 tons capacity and is crushed by jaw-crushers to about 2 in. ring, whence it passes to another bin and is fed by an automatic pulsatory feeder on to a conveyor belt, which discharges into an automatic cast-iron cone-sampler. This cuts out two samples across the whole stream of ore at every revolution, the remainder going by another conveyor to the battery-bins. Automatic devices deliver the ore into any individual bin as required. The first sample is passed to a small pair of rolls to be broken to about 1½ in. A second sampler cuts out another stream, the excess being returned to the main feed-belt of the stamp-bins, while the second sample is reduced by another set of rolls to less than ¼ in. and again sampled, the excess being returned by an elevator to the main-conveyor belt. The final sample falls on a special cement floor, where it is thoroughly mixed and quartered before laboratory samples are taken by an automatic machine.

The stamp-mill itself contain 40 stamps, built by the Power & Mining Machinery Co., each of 1040 lb. mounted on concrete mortar-blocks, with wood frames and iron stem-guides. The screens are of 3-mesh, Tyler's double crimped, using No. 19 steel wire; the duty from 2 in. ring to this mesh is 7·89 metric tons of dry ore per stamp. All the pulp from the batteries is elevated direct to a Callow sloughing-off cone, and the thick pulp is passed to two 24 in. duplex Callow belt-screens, which give perfect satisfaction and handle 80 tons per belt per 24 hours. The screens are 30 mesh, No. 31 steel-wire, plain woven. A set of screens lasts about 16 days, the old edges of the vanner-belts from the concentrators serving as sides for the belt-screens.

The over-size of the Callow screens goes direct to the Waddel type of Chilean mill. There are eight of these in operation, and two more will be erected soon. They consume about 48 h.p. each. From a series of tests it was found that they received feed all of which passed a 3-mesh screen at the rate of 70 kilo. dry ore per minute; this feed was free of all material that would pass 60 mesh and contained about 18% solid. Under these conditions the mills ground 20·44 kilo. per minute to a fineness sufficient to pass 200 mesh; therefore as compared to tube-mills at the Loreto, their efficiency averaged 0·42 kilo. per h.p. min. grinding to 200 mesh.

In actual practice these Waddel mills grind a total of about 44 tons each per day of 24

THE HACIENDA DE LORETO, AT PACHUCA.

In the foreground the horses are treading the charge on the patio floor; in the background a modern cyanide mill is now being erected.

hours from 3 mesh to 100 mesh. On reference to the flow-sheet, it will be seen that the coarse and medium coarse spigots of the classifiers discharge to 4 and 8 Wilfley tables, respectively, and the tailing from these tables is returned to the mills so that they continue to re-grind until all the material is fine enough to pass the fine-sand spigot, which delivers to the 12 Johnston concentrators. The undersize of the Callow screens passes to a set of hydraulic cones. The coarse, medium, and fine sands, respectively, are sent to the Wilfley and Johnston concentrators. The rest of the flow-sheet is self-explanatory. Three of the tube-mills in use were built by the Abbé works; they are 4 ft. 6 in. by 15 ft. long; one mill was built by the Denver Engineering Works and is 5 by 20 feet.

The general arrangement of the cyanide plant is similar to that of the Loreto. The average charge is 41·9 metric tons of dry slime per vat and the time of agitation is about 72 hours. The material used is as follows, in kilogrammes per metric ton of ore: 5 lime, 1·5 sodium cyanide, and 0·19 sodium acetate. The filter is a Butters, and centrifugal pumps are used for handling the solutions. The zinc-boxes have five compartments, of sheet-steel. Zinc shaving is used, packed very loosely.

In the whole of Pachuca I did not see a single automatic zinc-lathe such as is universally used in California and Nevada. I also made notes regarding various machines employed locally, and, as they may be of use to engineers in other parts of the world, I give them herewith: The fineness of the slime from the tube-mills is controlled entirely by adjustment of the overflow of the Dorr classifiers, the coarse material being returned in a de-watered condition to the tube-mill feed. Only trunnion-bearing tube-mills are used; outside roller-bearing mills are considered to be more liable to break-downs. Almost all the tubes are fitted with a plain worm-feed on the inside of the trunnions, as originally designed by Walter Neal of El Oro. These are found the most satisfactory. Each trunnion has a worm-feed toward the centre of the mill. Baffle-plates are used at the discharge end. The bearings sent by the manufacturers for the first tube-mills were altogether too light and too short, so that the latest specifications call for a special type of bearing. The gears of the Chilean mills are all made too light and increase the cost of maintenance. Manganese steel should be used. In the cyanide treatment itself opinions seems to be fairly equally divided as between mechanical agitation in open flat vats and the compressed-air agitation in Pachuca tanks. In the former, decantation of the rich solutions can be practised, the filter being only relied upon for washing. The area of ground occupied and the first cost are greater, and the general arrangement is more complex. In the latter, using Pachuca tanks, the slime must be thickened; hence the use of Dorr devices. Decantation cannot be practised, reliance being put on the filters. The advocates of each system claim that their cost of agitation is lower than the other. As to this I have no data, but it seems probable that the cyanide consumption would be slightly higher when employing Pachuca tanks.

The Guadalupe mill, which is being erected on the old Guadalupe *patio* of the Santa Gertrudis company, is nearly completed and is modeled on the experience gained at the San Rafael.* This plant is equipped with Pachuca tanks and a Moore filter. The accompanying photograph is of particular interest in that it shows the Patio amalgamation process in the foreground and the nearly completed cyanide-plant at the back. The new process is elbowing the old one into retirement.

Fatal Mining Accidents.—The Home Office has issued a forward copy of the report of the Inspector of Mines relating to fatal accidents in mines and quarries in the United Kingdom during 1909. The total number of fatal accidents in coal mines was 1176, and the number of deaths ensuing was 1447. These figures compare with 1138 and 1308, respectively, in 1908, so that there has been a slight increase. Of the separate causes, 20 explosions accounted for 28 deaths. Falls of roof caused 602 deaths, and shaft accidents 82; there were 406 other deaths underground and 130 on the surface. In metalliferous mines 38 accidents caused 40 deaths, and in quarries there were 83 fatal accidents causing 84 deaths.

In this connection the article by F. L. Hoffman in the *Engineering & Mining Journal* for December 25 shows a vast difference in American conditions. Mr. Hoffman writes about the increasing number of fatal accidents in coal mining the United States. During the year 2686 men lost their lives, which is at the rate of 3·96 per 1000. It is pointed out that this rate has been steadily increasing during the last ten years: in 1898 the rate was 2·59 per thousand.

* My thanks are due to E. P. Merrill, managing director for the Real del Monte, and to Capt. Frank Rule of La Blanca, Don Carlos de Landero of the Santa Gertrudis, and Mr. Henderson at Guerrero, and to C. L. King at Real del Monte.

COPPER MINING IN SOUTH-WESTERN ALASKA

By W. M. BREWER

THOSE parts of south-western Alaska in which copper mining is the chief industry are on the islands and mainland of Prince William sound as well as in the Copper River district, situated from 150 to 230 miles northeast from Valdez, which is the present distributing centre for this entire region.

The most productive of these districts as yet is, and promises to be for a long time, Latouche island; on the northwest side of this island is situated the Big Bonanza mine, which was located by A. K. Beatson and five associates, who, on July 4, 1897, staked six claims in a rectangular body 4500 ft. long and 1200 ft. wide. Since then there have been added eight more full claims and four fractional claims, so that today this property covers 4500 ft. along the strike of the mineral-bearing zone as well as all the territory extending from the outcrops westward on the dip to the shore line and about 6000 ft. along the west shore of the island. The mineral zone extends from north to south apparently the entire length of the island, or about 9 miles, but has attained its greatest dimensions and carries the richest ore on the Big Bonanza property. The country rock is principally slate and quartzite, overlaid in places by conglomerate, and the ore occurs between the slate and quartzite, with the former as the hanging wall.

Adit entrance of Big Bonanza.

Loading copper ore at Beatson's wharf, Latouche, Alaska.

Today this Big Bonanza group is the most important of any copper proposition along the entire coast line of British Columbia and Alaska, because of the extent of the orebody as well as the unusually high grade of the ore, which has been secondarily enriched to a depth of about 200 ft. below the apex of the outcrop.

On the Big Bonanza claim itself the orebody has been proved to a depth of 215 ft. and it is shipping ore. The outcrop appears in a bluff half a mile from the shore. Work has been concentrated on this bluff, the extreme summit of which is about 450 ft. above the sea-level and from an open-cut in its face about 20,000 tons of ore carrying from 8 to 15% copper has been sorted and shipped, leaving about 40,000 tons of low-grade ore and waste on the dump. Ore suitable for shipment was found to a width of about 70 ft. in the face of this bluff and the open-cut is about 250 ft. long.

The orebody has been proved below the floor of this cut by cross-cuts and drifts aggregating about 3000 ft. in length and to a depth of about 135 ft. On the lowest level ore is blocked out to a length of 300 ft., with an average width of over 30 ft., and an average copper content of about 6%. The faces of some of the openings that penetrate this orebody are still in ore and further development will undoubtedly show greater dimensions both in length and width.

The upper adit, driven about 100 ft. above the workings just described, first intersected 60 ft. of gossan next to the slate hanging-wall, then cut 80 ft. of solid ore carrying an average of 10%, then through 114 ft. of low-grade ore mixed with the quartzose rock of the foot-wall, and even beyond the rock still carried some copper ore along the cleavage planes of the numerous slickensides. On the lower level, while the high-grade orebody is about of the same dimensions as on the upper, yet this low-grade orebody is found to be of much less extent. Apparently, while the main fissure at the contact of the slate and quartzose rock maintains its continuity to still greater depths, the quartzose rock on the foot-wall side has become so much more massive that the impregnations of chalcopyrite found in this rock in the upper workings are wanting on the lower level.

The other points on Latouche island where mining operations are in progress are : Girdwood and Barrack's camp, about half a mile north of Beatson's ; Horseshoe Bay, about 4 miles south of Beatson's; and Murphy's camp, on the northeast side of the island. The only other property from which shipments have been made is that owned by Girdwood and partners and known as the Blackbird claims, the southern boundary of which forms the northern boundary of the Big Bonanza group.

Pounds.—In a recent issue of *The Daily Telegraph* we note a cablegram from its New York correspondent stating that "sellers of copper look for an increase in metal stocks this month, probably £5,000,000." Probably 5,000,000 lb. This illustrates the confusion likely to arise from the use of the same word to designate two different units of measure.

American Copper Shares.—In a recent circular issued by Hayden, Stone & Co. we find an interesting tabulation of copper production and earnings. The average return on the market price of the shares is only just 5%, with copper at 13 cents per pound. Obviously 5% is no proper return on such a speculation and it is apparent that buyers must expect to make money by favourable realization, rather than dividends.

	No. of shares	Present Annual rate of production	Cost per lb.	Earnings per share 13 c. copper	% on market price
Amalgamated	1,538,879	220,000,000	9½	$5·00	6·1
Anaconda	1,200,000	90,000,000	10	2·25	4·8
Butte Coalition	1,000,000	35,000,000	10	1·05	3·5
Calumet & Arizona	200,000	28,000,000	9	5·60	5·7
Calumet & Hecla	100,000	85,000,000	8½	38·25	5·9
Copper Range	384,188	33,500,000	9½	3·05	3·9
Granby	135,000	25,000,000	10	5·55	5·8
Greene Cananea	2,500,000	45,000,000	10½	0·35	3·3
Mohawk	100,000	12,000,000	10½	3·00	5·0
Nevada Consolidated	1,600,000	60,000,000	7	1·87	7·7
North Butte	400,000	45,000,000	9	4·50	7·8
Old Dominion	300,000	33,000.000	10½	2·75	5·6
Osceola	100,000	29,000,000	10¼	7·97	5·3
Quincy	110,000	21,500,000	10½	4·87	5·6
Shannon	300,000	18,000,000	11½	0·90	5·8
Superior & Pittsburg	1,500,000	25,000,000	9½	0·58	3·8
Tennessee	200,000	15,000,000	10½	1·87	5·5
Utah Consolidated	300,000	15,000,000	9	2·00	4·7
Utah Copper	735,000	60,000,000	8	4·05	8·8
Wolverine	60,000	10,000,000	7½	9·13	6·0

Transport under Difficulties.

The accompanying photograph illustrates a typical instance of transport of mining plant under difficulties. It shows the method that had to be adopted when shipping a heavy mortar-box to the Redjang Lebong gold mine in Sumatra. For some years sectionalized mortar-boxes had been used at the mine, none of the parts being over 800 lb. It was not deemed possible to bring anything heavier up the river and through the jungle, owing to the frailty of the available boats and the absence of rail communication. The stamps used were of the standard 1050 lb. type. The ore was so hard, however, that the sectionalized mortar-boxes were found to be unequal to the strain, and in 1907 it was decided to substitute solid Sandycroft mortar-boxes for them, trusting to luck and the exercise of wits to secure safe delivery. These boxes weigh over four tons. The first two were landed on the coast and carried up the river for 14 miles in native boats, as shown in the photograph. They were landed without any crane, but by means of native rope-tackle, and subsequently pushed over a bush road for 10 miles to the mine. The carriage of the boxes in the boats and the method of landing them were fraught with anxiety and there was a constant fear that they would find a resting place in the bed of the river and do damage to life and limb in their downward course. However, everything passed off safely. The remaining four boxes that followed did the journey in comparative luxury. They went up the river in the native boats, but were landed by a crane, and then hauled over a light railway, which had been built in the meantime.

Extracting Nickel from Matte.—In United States patent 934,278, D. H. Browne, of the Canadian Copper Co., describes a method of treating nickel and copper-nickel matte. The molten matte coming from the smelting furnace is introduced direct to an electric furnace together with lime. At the high temperature of the electric furnace the lime reacts with the sulphides, forming metallic copper and nickel, calcium sulphide, and sulphurous acid gas. The calcium sulphide being light may be easily skimmed off, leaving pure nickel or a mixture of nickel and copper. It is advisable to add some carbon to the charge in order to minimize the wear of the electrodes.

MINING IN SOUTHERN RHODESIA

By A. H. ACKERMANN

RHODESIA has passed through the various stages that usually mark the development of a new mining region. The boom, which lasted several years, left the country in a state of depression, and it is only within the last two years that the attention of the mining world has again been directed to this portion of Africa.

The period of stagnation that followed the boom can readily be understood when one considers the vast sums of money that were invested and lost in the country. However, even the most pessimistic must admit that Rhodesia is now progressing satisfactorily.

Taking into consideration the excellent facilities offered by the Rhodesia Railways throughout the country, the development of the mineral resources has been slow, but there are numerous reasons to account for this, the principal being the sparse white population and the fact that too much attention has been devoted to the many ancient workings scattered over the country. To emphasize the scarcity of white men, it is only necessary to state that there is but one white person to every 10 square miles.

There has been little incentive during recent years for men to go out prospecting unless in a position to develop their own discoveries, for conditions as they exist in Australia and in America do not prevail in Rhodesia. In the former country a miner can arrange to give up his position for a certain number of months during the year and go prospecting, with the knowledge that little difficulty will be experienced in finding another billet whenever he cares to apply for one. In Rhodesia, where white labour is chiefly used to supervise the black, it is not possible to find a position so easily, and those who have one are usually content to hold it just as long as they decide to remain in the country. Naturally, under such conditions there is little individual prospecting by the poor man, who has been responsible for a large proportion of mineral discoveries all over the world; and until there has been a considerable increase in the white population, it is not likely that Rhodesia will develop at the same pace as a country that is fortunate enough to have available a white community for its labour supplies.

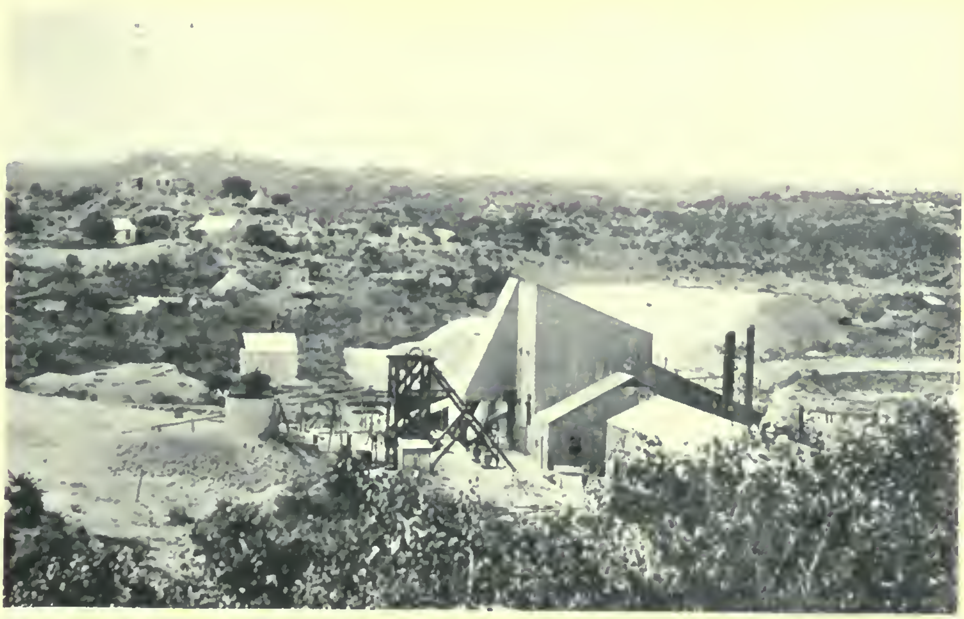
In the early days, when money was forthcoming for prospecting, the main object seemed to be to find 'old workings.' The system then in vogue was 'blanket prospecting,' the natives being given blankets in exchange for information regarding old workings. The prospectors found that there was a ready market for such undeveloped discoveries, which were readily bought by the large developing and exploration companies during the 'rush' or boom.

The old workings proved that gold existed in many localities, but they did not encourage systematic prospecting at first. To emphasize to what extent this system of 'blanket prospecting' was carried out, it is only necessary to state that out of over 300 lodes that are either producing or being developed today, only five or six were deposits that had not been discovered by the ancients.

When the country settled down to serious development it was found that an old working did not necessarily mean a payable mine, and it was proved beyond doubt that the 'old timers' had worked lodes that cannot be considered payable even in this day of economic mining. The realization of this brought depression. Companies found that they had either pegged or purchased a much larger holding in the country than they could possibly expect to work or develop, and as fresh capital was not forthcoming, the prospectors became disheartened and left the country for more likely fields. It was at this critical stage that the 'small worker' or tributor came into existence, the companies having decided to let on tribute such of their properties as were not considered large enough to be worked on a company basis. The royalty charged by the owners varies from 5 to 20% gross, the tributor in nearly every case being also required to pay the royalty due to the B.S.A. Company.

The majority of tributors have undoubtedly done well, and in many instances enormous profits have been made, a fact that is amply borne out by statistics, which show that over 40% of the total gold output of Rhodesia is produced by the 'small worker.' It must be realized now that Rhodesia owes much to this enterprising and hard-working community, and despite the unfavourable criticism expressed at the outset, there is no doubt now that the 'small worker' has come to stay, and is likely to prove the most important factor

GENERAL VIEW OF THE SELUKWE MINE RHODESIA.



THE GAIKA MINE, IN RHODESIA.

in the future development of Rhodesia.

The progress of the country has also been retarded by the lack of a settled community. As soon as a fortune was made it was considered to be quite the correct thing to leave for a country more civilized. This may have been excusable in the early days, but now it is to be hoped that a better spirit will be shown toward Rhodesia, and that the fortunate ones will be content to settle down in the country, and thereby contribute to its prosperity.

Having endeavoured to explain some of the difficult problems that Rhodesia has confronted, I pass on to a brief description of the present position and future possibilities. Southern Rhodesia comprises an area of approximately 150,000 square miles, containing a white population of about 16,000 and a black population of 682,000. The principal towns are Salisbury and Bulawayo, the former being the capital and seat of the administration, while Bulawayo is the commercial centre.

The climate is most agreeable, and so long as people take reasonable precautions and lead steady lives, there is little chance of their health suffering in any way. Generally speaking, the country is well watered, and no great difficulties have been experienced, as on other goldfields, in getting the necessary water for ore-treatment. Timber for mining purposes, and for fuel, is fairly plentiful in most parts, and the mines situated near the railway have the advantage of obtaining Wankie coal, which is recognized as one of the best coals found in Africa.

The mines, as already stated, are worked by native labour, the average wage being about 30s. per month, plus an additional cost of about 14s. per month for food. There are approximately 1550 Europeans and 30,000 natives employed in mining, but the native labour supply is always insufficient to cope with the ever-increasing demand. Arrangements are now being made to introduce native labour from Northern Rhodesia and Nyasaland, where it is hoped a plentiful supply may be obtained.

The problem of native labour is the most difficult that the mining community has to face, and as the industry increases the position must become more critical. Even today, during the rainy season, when the natives are anxious to attend to their crops, it is in many cases quite impossible to keep development work going, with the result that mines, under these circumstances, are being depleted of available reserves, while fresh reserves are not being created. Certain mines might be mentioned that would probably be working today, had it not been necessary to shut-down owing to shortage of labour, the consequence being that the workings are now filled with water. The mines most affected are the large low-grade propositions, where a full complement of native labour is absolutely essential to successful work. It is difficult to say how this grave problem may be solved, but it is to be hoped that the recent arrangements made by the Government will solve the problem.

Generally speaking, Rhodesia may be looked upon as a country of small propositions, where 5 and 10-stamp mills predominate, but this does not necessarily mean that all the mines are small, for, on the contrary, there are such large propositions as the Wanderer, Bush Tick, Globe & Phœnix, El Dorado, Selukwe, Surprise, Penhalonga, Giant, Jumbo, and East Gwanda mines. The principal mining districts so far developed are Bulawayo, Selukwe, Hartley, Lomagundi, and Umtali.

In addition to gold, considerable quantities of silver, copper, lead, chrome iron, coal, and other minerals have been discovered. Diamonds have also been found, and what is believed to be a large pipe, similar to that discovered at Kimberley, is now being developed by the South African Option Syndicate.

The following figures will suffice to emphasize the rapid strides that the mining industry of Southern Rhodesia has made during recent years:

	Value of Output.		
November 1891 to December 1898	£83,052	1904	969,343
1899	205,690	1905	1,449,985
1900	308,249	1906	1,985,099
1901	610,389	1907	2,178,886
1902	687,096	1908	2,526,007
1903	827,729	1909	2,623,788
		Total	£14,455,313

The production for the month of December 1909 was:

Gold	55,446 oz.
Silver	19,845 ,,
Lead	72 tons.
Copper	13 ,,
Coal	13,584 ,,
Chrome Ore	1,120 ,,

The number of producers is 208, and the value of the gold produced £233,397. The increase for the year as compared with 1908 amounted to £97,781.

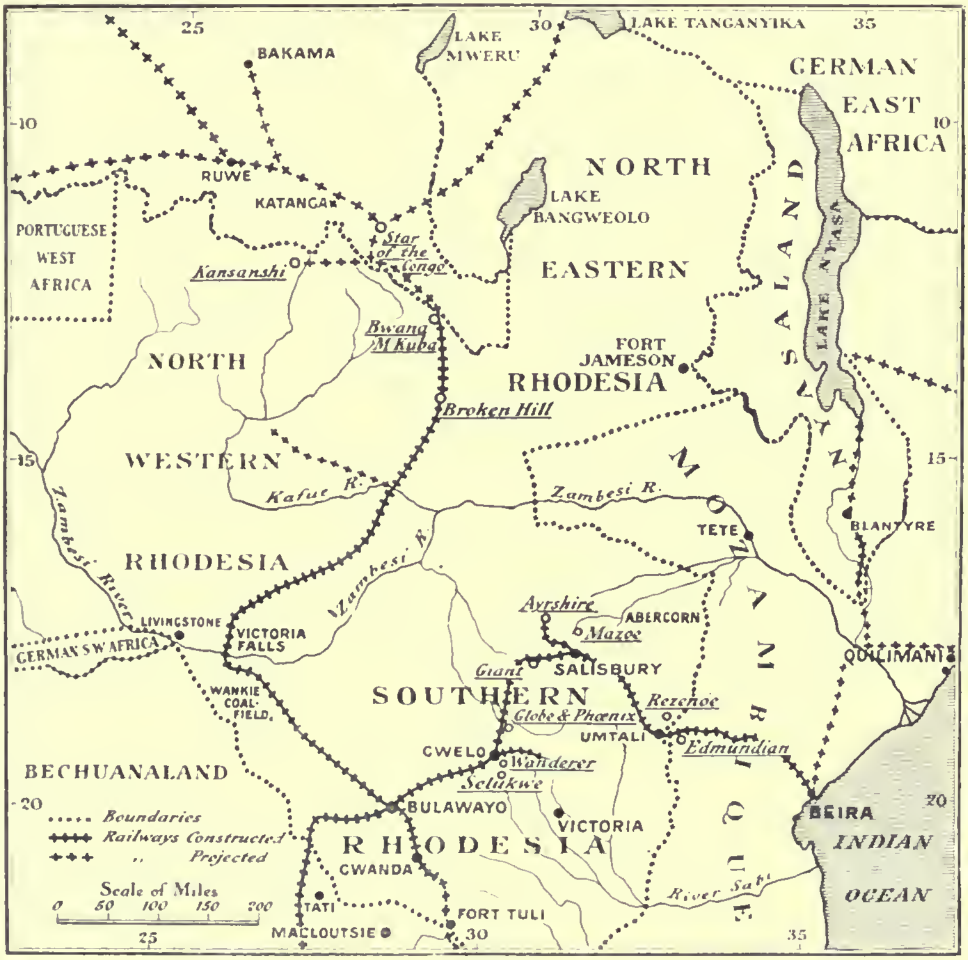
The number of tons of ore crushed during

1908 was 1,819,952, yielding in all 606,961 oz. gold, equal to a recovery of $27\frac{3}{4}$ shillings per ton of ore milled. The number of properties actually producing gold during December 1908 was 221, as compared with only 33 in December 1903.

The distribution of gold throughout the country is unique, the auriferous quartz veins being usually confined to the metamorphic rocks, occurring generally in schist and banded iron-stone, and occasionally in conglomerate. The veins usually conform to the stratification. The veldt is usually covered with several feet of soil, which makes prospecting difficult, and in such cases it is only by systematic operations that the underlying ore will be discovered.

The 'fossicker,' who has played an important part in the opening up of most mining regions, is practically an unknown factor in Southern Rhodesia, and this type of man is much wanted. Capital can be profitably employed by the formation of small syndicates to finance such men in systematically prospecting the country, for it seems incredible to assume that the ancients have discovered even half the gold-bearing deposits of so extensive a region.

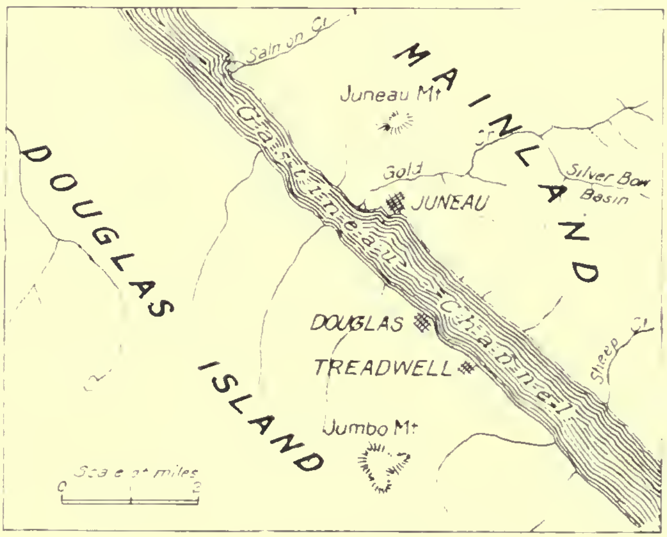
In conclusion, bearing in mind the enormous extent of country that has never been prospected nor even scratched, and the fact that attention has been directed to the existing mining districts only by the discovery of old workings, it can be said that for capable men prepared to prospect systematically Southern Rhodesia offers splendid opportunities.



RHODESIA.

THE TREADWELL MINES

The important group of gold mines at Treadwell on Douglas island, Alaska, has attracted the attention of investors in England. In this case the term 'investor' can be used advisedly, as the mines are steady in their production and the shares of the companies controlling them are desirable for their regular dividends rather than the enhancement of the quotation. What fluctuation there may be, is largely seasonal; for in winter the stamp-mills suffer for lack of water-power as compared to the summer, when the melting snows provide an excess of water. Recent developments underground have proved encouraging and demonstrate that these enormous bodies of low-grade ore persist in depth, so that, with unusually careful and skilful management, the outlook is decidedly cheerful. The parent company is the Alaska-Treadwell; immediately to the south is the Alaska Mexican, and next is the Alaska United, which owns the Ready Bullion and 700-Foot claims. All of them are under the same direction, Robert A. Kinzie being resident manager, and F. W. Bradley, of San Francisco, consulting engineer. The president is H. H. Taylor, who as the nominee of the late D. O. Mills, of New York, represents the controlling interest. The shares are quoted in London and have appreciated considerably during the last year. And for good reasons. The mines are now in excellent physical condition; they all had their good ore at the surface, their poor zone in the shallow workings, and the bottom levels are now in good ore again. The deepest workings average about 1200 ft. below the sea-level, while the poor zone was at about 600 ft. The ore in the bottom is just as wide as it has ever been at any level and is yielding a larger profit simply because the working cost is steadily being decreased. The orebodies are in the nature of pipes, rather than ordinary ore-shoots, for the longest dimension is the vertical one. A life of fully 10 years is practically assured for each mine and there is promise of further ore reserves being developed. It seems a pity that the three companies are not consolidated, the ownership and management being so nearly identical.



The Treadwell mines, Alaska.

The cost of power is to be decreased by the erection of a central electric plant, so as to electrify all the underground machinery and all the small surface equipment. The ditches already built are being enlarged so as to run this central power-station by flood-water for half the year. It is probable that the new pipe-lines will enable the Ready Bullion and Mexican mills to run throughout the year with water-power. Systematic work is being done steadily to enlarge the water-storage capacity required for these mines. Thus the greater consumption of power due to increasing depth will be compensated. But the fluctuation in the output of the Alaska-Treadwell itself is still unavoidable, because the 300-stamp mill is closed down each winter, leaving 240 stamps at work. The big mill is run only by water-power, which during freezing weather is inadequate. During the shut-down the full crew is kept at work underground, with the result that the winter months exhibit decreased profits, the expenses being maintained at their normal rate while the income of the company is curtailed. If this fact is clearly understood by the shareholders, they will be saved needless anxiety. The running of the 300-stamp mill depends on the weather; hence the management is unable to forecast the output of gold. A long and severe winter cripples the Treadwell; a mild one assures unusual prosperity.

PRÉCIS OF TECHNOLOGY

The Management of Employees.—Some excellent advice to employers of labour is given by H. P. Gillette in a paper read before the American Society of Engineering Contractors. Mr. Gillette is well known as the author of books on rock-excavation, earthwork, and similar subjects, and also as one of the editors of the *Engineering News*. In the present paper the author strongly recommends engineers in charge to devise methods of payment according to results. His principle is the "law of reward increasing with increased performance." Such a law seems self-evident, but it is seldom adopted in practice and still less often worked successfully. It requires a good manager to inaugurate a satisfactory system, and it requires a just and honourable one to adhere to it and so win the confidence of the men. On general principles it may be said that the failure of the system of payment according to results is due almost always to the subsequent cutting of rates and the breaking of an implied agreement, on the part of greedy or short-sighted masters. So often has such ungenerous conduct been exhibited that such contracts are usually regarded with suspicion by the workmen, who infer that the offers are made solely as a temporary device to get as much out of a man as possible. How can the confidence and esteem of the men be won if the agreements to pay according to results are not considered permanent? This cutting of rates demoralizes the men and makes them indifferent. Their efforts and ambitions are not honourably appreciated, and consequently they often prefer the dead level of a trade-union day-wage. An employer must make it a principle to give his men a large proportion of the product of their increased efforts, and to continue favourable contracts in perpetuity. In this way he will make the men's interests his own; he will speedily build up an industrial clan of workmen as loyal to him as were the old Scottish clansmen to their chief. Men never begrudge a leader a generous share of the spoils of war or the profits of peaceful industry provided the leader has been generous in his division of the gains among the men of the ranks.

Mr. Gillette devotes much consideration to the unit on which to found the estimate of work done. An example will show the meaning of this point: Suppose it is the laying of a macadam road that forms the subject of the contract. Rock-drillers, shovelers, teamsters, crushers, spreaders, and roller-men are all required to get the stone from the quarry and lay it in position. Each of these different sets of men are usually paid according to the number of square yards of paving laid down, this unit being used for the sole reason that the contractor is paid on this basis. But the system is not just to the individual men. The crushing machine may get out of order, the teamsters may be dilatory, and so forth, so that though the rock-drill gang may be expert and rapid workers, the fault of some other part of the system may vitiate their efforts. Consequently Mr. Gillette recommends that the units of work should differ according to the work done. The rock-drillers should be paid upon the basis of the length of hole drilled; the shovelers and crusher men upon the quantity handled; the spreaders upon the cubic yards covered; the teamsters upon the ton-miles; and the roller-men upon the miles travelled. Take in detail the last item, the work of the roller-men. It is not fair to pay them by the amount of ground consolidated, for the nature of the subsoil and foundations varies with every job and consequently the time occupied in consolidating the ground is never the same. To pay by the actual distance covered is the only fair way. This system has a marvellous effect. First a 10-ton roller gives way to a 15-ton machine with wider tires, then the higher speeds are more often employed. A larger water-tank comes into use and no stops are taken in the middle of work for the purpose of filling it. Steam will always be up and ready to start at the beginning of the hours of work. The men will also be keen on getting good coal. There is no stimulus comparable to the stimulus of paying men in terms of the best unit of work.

Mr. Gillette has also some remarks to make about the payment of men during the time that there is no work ready for them to do. The usual way of paying piece-work men under such circumstances is to pay an hourly wage, but Mr. Gillette is in favour of paying them for every hour of unoccupied time on the basis of the average earnings made by each individual man while at work. At first sight this may seem an encouragement of break-downs, and if some penalty is not imposed to counteract such occurrences, the whole system of payment may possibly be thrown out of joint. Consequently the author finds it a good plan to make deductions for stoppages. For instance, in the crushing department the engine-man forfeits a dollar for every hour lost through the idleness of his machine in excess of three hours per week. With a rule of this sort, the engine-man becomes alert. In one case quoted by the author one of the sprocket-chains on the bucket-elevator broke regularly every day. The engine-man imputed the mishap to the poor quality of the steel and to the lightness of the chain. When, however, he heard of the new rule about losing pay for stoppages, he brightened up his wits and discovered that the cause of the accidents was the tightness of the chain, which allowed no leeway when a piece of stone lodged between the chain and the sprocket-wheel. It is not fair, however, to dock the workman's wages for every hour of stoppage over the three hours a week without also encouraging him to reduce the three hours; therefore a bonus is given for every hour saved out of these three hours. In general terms, therefore, the rule about payment during stoppages is that men should be paid at the rate of their average earnings during such stoppages as are not due to their own fault; that heavy penalties should be levied on those that are responsible for them, at the same time giving a bonus for the reduction of lost time below a given standard.

There are a great many classes of work where a suitable unit cannot be found, due to the difficulty of making accurate measurements without going to too great a cost. For instance, the author desired to pay draughtsmen on this system, but could not find a practicable unit. His efforts afford amusing reading. His first suggestion was that a draughtsman should be paid by the number of linear inches drawn, but it was pointed out that the measurement would be no small task, besides there being a difficulty in making records relating to where each day's work started and ended. As an alternative he suggested that a standard might be based on the amount of ink used per day, but such a method would be open to abuse.

It will be readily seen that there are a great many cases where accurate gauging of work cannot be done, and some employers of labour will probably scout Mr. Gillette's propositions as impracticable. However, the author points out so many cases where they can be profitably applied that what is required is not so much the genius for devising units of measurement as common sense in applying those that are obvious.

Power in Electrolytic Refining.—The process for electrolytically refining copper consumes less power than most electro-chemical reactions, for the current meets no opposing electro-motive force from the decomposition of the electrolyte, but has only to overcome the ohmic resistance of the electrolyte and the metallic circuit. Nevertheless, as the cost of the power required is quite 40% of the total cost of the electrolytic operation of refining, the study of economies from the electro-chemist's point of view is of value. Hence the paper read at the November meeting of the American Electrochemical Society, by W. L. Spalding, of the University of Buffalo, is of interest, as it contains suggestions as to economies in the sources of power. The process has the advantage of being continuous day and night, so the load is constant. This fact makes for economy if the power is produced on the spot, and ensures specially low rates if the current is bought from an electric power company. If it is possible to use both sources of power, then it is advantageous for the refiner to use his own power during periods of the day when the power company has the largest demand from other customers, and to use the bought current when the power company has an otherwise light load, because under these circumstances a lower price can usually be obtained.

In producing his own power, the refiner has several opportunities of securing economy. If the refinery is at the smelting works, there is an ample source of power in the waste gases of the reverberatory and blast furnaces. These can be utilized under boilers for the generation of steam, but as their supply is irregular owing to the furnaces being intermittently in blast and to the stoppages of the reverberatories for repairs or fettling, some other source of supply to equalize the power must be provided. If only refining is done at the works, the gases given off during the subsequent poling may be utilized, but the supply is small and only lasts for perhaps two hours every day. At the present time gas-engines are rarely used, though with auxiliary gas-producers they should give a regular and dependable supply of power. A further application of gas-producers would be the generation of gaseous fuel for the smelting furnaces. It is, however, more usual to employ batteries of coal-fired boilers in parallel with waste-heat boilers. Sometimes the waste heat is used for preliminarily heating the boiler-water before going to the coal-fired boiler.

With regard to bought electrical power with no other source of supply, it would be possible to contract for an additional supply of current during the power company's slack hours, over and above the regular supply covering the whole 24 hours, at a price lower than the regular supply. It is true that the current-density would increase at these times, but the deposition of copper can proceed satisfactorily under a wide range of current-density. It must be remembered when calculating the saving due to this cheaper power that the cost of power per ton of copper is approximately proportional to the current-density, and too great an increase in the density would overbalance the saving due to the cheaper rate. It is possible also to arrange the work so that the density may not be increased to so great an extent; for instance, the tanks with insoluble anodes used for depositing excess copper from the electrolyte may be placed in circuit when the current-density is likely to be greatest. Each of these consumes about eight times the energy of the ordinary tank, because electrolytic decomposition is effected, so that if their number is 2% of the total number of tanks their resistence is 14% of the total.

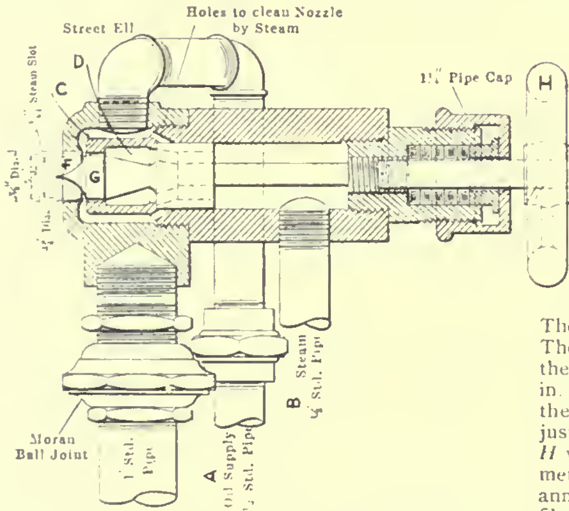
The price of bought current varies according to the district. For instance, the price of Niagara Falls power at Buffalo is far too high, considering the vast resources available. When the contract is for 500 h.p. or more the charge is \$27·50 per horse-power per year, which, when the alternating current is converted to direct current at 87% efficiency, comes to a cost of \$31·60 per h.p.-year. The reason for this high price is the fact that the supply company has the monopoly in Buffalo, and its only competitor to consider is steam.

When a refiner uses both waste heat and bought current, the problem is to combine the two in such a way as to secure a minimum cost. The most satisfactory way seems to be to supply the tank-house circuit from two generators in parallel, one driven by a motor operated by the bought current, and the other by a steam-engine with a load varying with the amount of waste-gases available. This arrangement makes it possible to divide the load in any ratio either by hand or automatically; or the engine may be stopped on Sundays and on occasions when the supply of waste-gases is limited. There is some disadvantage in this arrangement due to the delicate equilibrium of the two loads at large ratios; when taking the load off both machines and the rheostats are not turned simultaneously, one may overpower the other, but as the direction of rotation of a shunt-wound generator is not changed when run as a motor, no harm is done. An arrangement of the generators in series with half the circuit interposed between them would divide the voltage between the tank-house terminals and decrease the loss of current through grounds, but excessive sparking due to heavy amperage in a weak field would not allow the engine-driven generator to carry as small a load at periods of small steam supply.

It is usual to charge for current by the maximum two-minute peak occurring during each month, and these peaks are recorded by a watt-meter. It is therefore necessary to keep a close watch on these peaks so as to prevent the price being too high. This is best done by an apparatus that automatically changes the resistance of the shunt-field circuit of the generator when the watt-meter in the motor-circuit records more or less than the desired quantity. With this attachment the maximum two-minute variation from the average load will be less than 5 kw. As in the case of varying amounts of bought current, already mentioned, this arrangement also involves a variation in the current-density, but means can be devised for reducing the density at times when it is inclined to be great. In addition to the devices with this object, mentioned above, part of the current from the waste heat, when greatest, may be used for storing up the heat in the electrolyte, and the round of metallurgical operations may be readjusted so that the interruptions in the supply of waste-gases may be spread more evenly over the day.

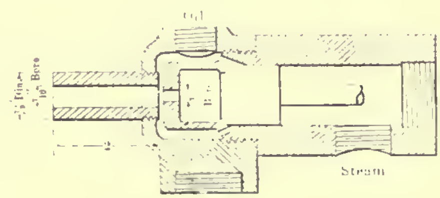
As the problems of cheap electrolytic refining and the details of its study are receiving increased attention, owing to the erection in various parts of the world of gigantic central electric stations, Mr. Spalding's paper is of timely interest.

Geological Value of Drill-Cores.—It is seldom that the cores of diamond-drills used in exploratory work are preserved, and still more seldom is an examination made of them other than for metallic contents. It is obvious that such cores would be of great assistance to the geologist. Nowadays mining regions are continually being examined by scientific geologists, so that it is well to draw the attention of mining engineers to the subject. As is generally known, J. Malcolm Maclaren is engaged on a geological survey of the principal mines in the Kalgoorlie field, and he has addressed a letter to the Chamber of Mines of Western Australia. This letter is published in the Chamber's *Monthly Journal* for November, and we herewith quote his remarks. During the course of his geological examination of the Kalgoorlie field he has been much impressed with the great value of drill cores, but he has been disappointed to find how small a proportion of the records of many miles of drilling are now available for reference. Many inferences he has made, now lacking confirmation, would have been proved or disproved if the cores had been generally preserved. It appears to have been the usual practice to throw away the cores directly it was ascertained by inspection that they contained no valuable metals. Again, when cores are more carefully assayed the whole of the core is used for this purpose and none preserved for future reference. As it is readily conceivable that future developments may render a re-examination of the drill-tests desirable, he suggests that in addition to keeping records in the books all cores should be preserved



wherever possible, and split longitudinally by hand, or by a simple rock-splitting machine such as can be designed and made at any mine. The split cores could be conveniently stored in empty dynamite-boxes, taking care to settle on a definite order of packing. It would not be necessary to separate the cores longitudinally, though the layers should be kept apart. At the present time such cores as are preserved often become useless by the gummed paper labels being obliterated or detached, so Mr. Maclaren suggests that the number of the bore and the footage should be painted as early as possible on the cores themselves at frequent intervals. An excellent and simple paint for this purpose can be easily made by dissolving high-class sealing wax in methylated spirit so as to form a viscous liquid. It is obvious that the labour of splitting, cutting into lengths, painting records, and packing, is comparatively trifling, and the cores thus stored occupy little room. In this way the preserved halves of the cores can be made of great value for future reference to both the geologist and the assayer.

Oil Fuel in Reverberatories. — In our December issue we gave an abstract of L. D. Ricketts' paper on reverberatory practice at Cananea, read before the Institution of Mining & Metallurgy. In this paper Mr. Ricketts mentioned that oil-fuel was used, and that Mr. Shelby had invented a burner for the purpose. No description of this burner was given at the time. It has, however, been since described and illustrated by C. F. Shelby in the ***Engineering & Mining Journal*** for January 1. When oil was first used, burners designed for making steam were employed, but these were found unsuitable because they produced complete atomization immediately, with the consequence that the heat was all at the burner end of the furnace. It was in order to get the long flame required in the reverberatory that Mr. Shelby designed his burner, which imparts greater velocity to the stream of atomized oil and so tends to prevent immediate combustion. The burner shown in Fig. 1 is mounted on a ball-joint so that the direction of the jet can be varied. The oil enters through the pipe *A* and passes into an annular chamber *C*, and is discharged through the orifice *F*, which is ⅞ in. diam. The oil is pumped in at a pressure of 40 lb. The steam at 125 lb. enters at *B* and passes into the chamber *D*, which fits within the chamber *C*.



The oil is thus partly heated before emerging at *F*. The steam passes through an annular aperture behind the opening for the oil. The annular space is 1/64 in. wide and consists of the space between the wall of the chamber *D* and the piston *G*. This piston is adjustable, and can be withdrawn by means of the wheel *H* when the burner requires cleaning. The full diameter of the steam aperture is then 25/32 in. The annular current of steam comes in contact with the film of oil emerging from C and throws it forward with great velocity. This design gives the best results, but it is necessary to have the apertures machined correctly, otherwise the flame may be thrown too much on one side. Consequently another design has been used; this is easier to make, as shown in Fig. 2. Instead of an annular space fitted with a piston, a smaller aperture is made 7/32 in. diam. in the end of the steam-chamber, and no piston is used. The area of this aperture is the same as that of the annular aperture. This burner will throw the jet even farther than the other. Mr. Shelby adds that these burners are not patented. Probably they would be applicable for other work than reverberatories, such as rotary cement-kilns.

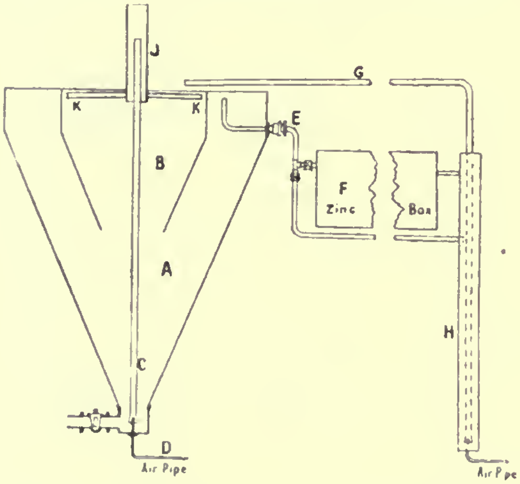
Electrochemical Analysis.—At the November meeting of the American Electrochemical Society held at New York, Edgar F. Smith, professor at Pennsylvania University, gave an address on recent advances in electro-chemical methods of analysis. This is reported in the December issue of the *Electrochemical and Metallurgical Industry*. Among other examples, he mentioned his rotating anode, which provides a good stirring of the electrolyte, thereby permitting the use of a higher current-density, which gives the advantage of increasing the rapidity of the analysis. He also referred to the use of a mercury cathode for depositing metals. The amalgam formed is weighed and the amount of metal thus determined, while the solution is titrated for the anion, if it remains in the electrolyte, such as is the case when a sulphate is being analysed with a platinum anode. It is possible, however, to catch the anion by using a suitable metallic anode. For instance, a silver anode may be used when analysing chlorides, as the silver will catch the chlorine; and calcium hydrate may be put on a platinum gauze anode and used for catching the fluorine given off when analysing fluorides. A third apparatus described by Mr. Smith was the double-compartment cell in which the mercury acts as a bi-polar electrode. This is used for the analysis of sodium and potassium salts. In analysing sodium chloride, for instance, the salt is placed in the inner of the two compartments; the chlorine is caught by the silver anode, and the sodium by the mercury cathode. The sodium amalgam thus formed is brought over to the second, or outer, compartment, which contains water, and sodium hydrate is thus formed. This arrangement is similar to the Castner-Kellner cell. For the analysis of potassium sulphate the same double cell may be used with a platinum anode, yielding potassium hydrate in the second compartment and sulphuric acid in the first. A most interesting experiment in connection with radium may be shown with such a double cell. If barium chloride containing radium is treated in this apparatus, the radium makes its appearance in the outer cell and the barium chloride in the inner cell loses its radioactivity.

Titaniferous Iron Ore.—F. W. Harbord was present at the November meeting of the Chemical, Metallurgical, and Mining Society of South Africa, and offered some remarks on titaniferous iron ore, which was the subject of a paper by Professor G. H. Stanley. As Mr. Harbord is in South Africa on a special mission in connection with the iron ore resources of that country, his opinions are of interest. He stated that he did not think the prejudice against this class of ore was fully justified. He had repeatedly tried to persuade English ironmasters to use small quantities in their charges, and gradually to increase the amount if the results were satisfactory. Mr. Rossi's experiments in America had been successful technically, though work on the Adirondack deposits had failed. The efforts now being put forward to re-open these deposits seemed more hopeful. The ordinary blast-furnace manager always argues that a fluid slag cannot be maintained and the furnace kept open if titaniferous ore is used, but Mr. Harbord has never yet found an English manager who was able to substantiate this opinion from his own experience. On the other hand, he is acquainted with the work at one particular plant, and an extensive one, where charges containing 1% of titanium have been used for years with perfectly satisfactory results. With regard to the fluxing of the titanium, the difficulty seems to be that the oxide sometimes acts as an acid and at other times as a base. The usual assumption is that it acts in the same way as silica, and that it is therefore necessary to add lime. It is probably due to this idea that so much trouble has been experienced. When this point has been thoroughly investigated, the question of using these ores will be greatly simplified.

Alkalinity of Cyanide Solutions.—At the January meeting of the Institution of Mining and Metallurgy, Bede Collingridge contributed a paper describing a method of testing cyanide solutions for protective alkalinity. He has found that the potassium iodide used as an indicator vitiates the test by showing apparently more alkalinity than is present. Indeed, it shows the presence of protective alkali when none is actually there. The author considers that much cyanide is allowed to decompose owing to the test giving an erroneous impression that protective alkali is present. As an alternative test he proposes the following: Into 10 c.c. of the test solution, using potassium iodide as indicator, run standardized silver nitrate until a deep brown colouration of silver iodide is clearly shown; then note the amount of silver nitrate used. Into another 10 c.c. of test solution, without adding potassium iodide, run twice the quantity of silver nitrate that was necessary in the first test in order to make sure of getting rid of the alkalinity due to cyanide; then add phenol-phthalein and titrate with standardized acid; the result will give the protective alkalinity. A variation of this method is the following: Into a measured portion of the test solution to which has been added phenol-phthalein as indicator, run silver nitrate until the indicator colour remains constant, and then titrate with standardized acid.

Leaching Complex Ores. — In the *South African Mining Journal* for December 11, William Bettel gives an interesting discussion on the application of wet methods to the treatment of complex ores which are more usually sent to the smelter. Much of his paper deals with the circumstances when it is possible to extract gold, silver, and copper from such ores, but the most interesting part is his account of the method he devised nearly 20 years ago for the treatment of the ore at the Willows mine in the Transvaal. This mine did not last long, so the actual performance of the process did not extend over a great period of time. As during the past year the somewhat similar ores at the Gevonden mine have been tested by the author by means of practically the same process, some account of it will be of more than academic interest. The Willows ore was unusually complex, and its ultimate constitution was never exactly known. The chief valuable constituent was tetrahedrite consisting of sulphantimonides of iron and copper, and containing silver. When the author was asked to advise, the richer ore had been shipped abroad, leaving the oxidation products, of comparatively low grade. There were copper oxides and carbonates, silver sulphide, native silver, tetrahedrite enriched in silver, with many oxidized compounds of antimony and arsenic and also small amounts of bismuth, lead, and zinc. The origin of many of these less important constituents was no doubt the complex and obscure compounds of antimony with the various metals, such as partzite. The gangue consisted of carbonate of iron, with carbonates of lime, manganese, and magnesium. Sulphatized compounds of iron and copper were also found. It was out of the question to smelt for the copper and silver. If there had been a lead smelter in proximity treating dry ores, the Willows ore with its large proportion of carbonate of iron might have been acceptable as a flux. The author tried every kind of leaching process on the ore, raw, calcined, and chloridized, but obtained practically no extraction of the copper and silver. Finally he evolved a process that gave a remarkably complete extraction. The method consisted of treating the powdered ore in a hot concentrated brine solution, containing some free hydrochloric acid and the two chlorides of copper and iron. The result of the reaction was to dissolve the copper and silver and form argentous and argentic chlorides, and cuprous and cupric chlorides, which with ferrous chloride, also formed, were all soluble in the brine. Sulphur was given off; insoluble antimonite and other compounds were also formed. The solution had an upward circulation, and agitation was used. The first discharge from the top contained some silver and copper and carried with it the slime. When nothing but sand was left in the vat, leaching was continued until practically all the copper and silver had been extracted. The first solution was allowed to act further on the slime, and then the latter was separated by decantation. The slime contained most of the antimony, which was then recovered by smelting. The method adopted for recovering the silver and copper from the solution was first to precipitate the silver on copper and then to precipitate the copper from a portion of the solution by passing it over iron The remaining solution would then contain as much copper as was originally in it. By adding calcined dolomite the excess of iron salts was removed, and a certain amount of sodium chloride would be added to bring the brine up to strength. It will be seen that by this method the hydrochloric acid radicle is continually regenerated at an extremely low cost.

Extraction of Gold from Slime.—At the November meeting of the Chemical, Metallurgical, and Mining Society of South Africa, Andrew F. Crosse read a



paper describing his method of extracting gold from slime. The apparatus is smaller than that required for decantation and is simpler than a press. It has the special advantage of making a high extraction from slime that is difficult to wash. The accompanying diagram shows the method of operation The slime having been collected and the excess of water removed, is fed into a conical vat *A*. Circulation of the slime is effected by an air-lift operated through *D* and *C*. This carries the slime into the reservoir *J*, from which it descends through the radial pipes *K* into the space within the inner cone *B* Cyanide solution is also introduced into the inner cone. The slime gradually settles, and the solution in the upper part of the annular space between the two cones becomes clear. The clear solution is decanted through the pipe *E* to the precipitation-boxes *F*, from which the barren solution is returned by the air-lift pump *H* through the pipe *G* to the inner cone *B* It will be seen that the advantage of having the vessel *A* conical in shape is to allow the upward movement of the solution to be so slow at the top as to ensure no slime going into the zinc-boxes.

This process has been found effective with clayey, and ferruginous slime, and with high-grade concentrate of 'black sand.' In the case of a ferruginous slime the author obtained 93·2% extraction when the filter-presses could only yield 61% owing to the impossibility of removing the gold solution by washing the cakes. In order to find out the rate of replacement of the solution the author tried experiments with common salt instead of cyanide. He found that in a pulp containing 20% of dry slime he could obtain a clear overflow of 18% of the contents per hour, and that when a volume of solution equal to the solution in the vat had been replaced by water running into the inner cone, 75% of the salt had been removed. In starting the process with new solution, no extraction would take place for a couple of hours, so the circulation through the zinc-boxes is not commenced at once. It is desirable to maintain the circulation between the inner and outer cones during this preliminary work, so holes are arranged in the inner cone *B* just below the surface of the solution in the outer space. When circulation through the zinc-boxes commences, these holes are closed. As an addendum to Mr. Crosse's paper, Fraser Alexander read an account of the working of the process on the 'black sand,' that is, pyritic concentrate, at the Crown Mines. An old water-purifier was used for this purpose, 18 ft. deep, 4 ft. 3 in. wide at the top, and tapering to 2½ in. at the bottom. It was started in October 1908, and during twelve months it treated 30 tons of 'black-sand.' Each charge consists of 500 lb. and occupies 24 hours. The content of the charge averaged 23 oz. per ton, and an extraction of 96·88% was obtained.

Decomposition of Sulphates.—Now that so many metallurgical processes depend for their success upon the maintenance of a definite roasting heat, it is necessary to have more exact information relating to the temperature of certain reactions. W. S. Landis has recently conducted experiments with the object of ascertaining the temperatures of decomposition of the sulphates of copper, zinc, and iron in currents of hot air. These investigations were not conducted with the extreme accuracy demanded by the physicist, but under circumstances similar to the actual conditions existing in a roasting-furnace. His method and results are given in the January issue of *Metallurgical and Chemical Engineering*. The method of measuring the temperatures was as follows: A porcelain boat carrying the sulphate in a porcelain combustion-tube was placed in a combustion-furnace, and on the surface of the sulphate was laid the hot junction of a Le Chatelier thermo-couple, the cold junction of which was in melting ice. One end of the combustion-tube was connected with a three-mouthed bottle containing a solution of caustic soda carefully neutralized with sulphuric acid, using methyl orange as indicator. The connecting tube was passed well underneath the surface of the solution. The stem of a separatory funnel was arranged through the central mouth of the bottle and in the bulb was placed a dilute solution of caustic soda. The third mouth of the bottle was connected with an aspirator, which served to induce the necessary air current. When decomposition occurred the sulphurous and sulphuric gases passed along with the air into the solution in the bottle and affected the indicator. The introduction of caustic soda from the separatory funnel allowed of this acid being neutralized and served to keep the apparatus in continuous working order. Some idea of the rate of decomposition could be gained by the amount of caustic soda added to keep the indicator neutral.

When experimenting on zinc sulphate the first traces of decomposition appeared at 730° C. and the amount gradually increased as the temperature was raised to 760° C. At this point the decomposition was rapid and the whole of the acid was removed.

With copper sulphate the first traces of acid appeared at 400° C., and only small amounts were given off as the temperature was gradually raised to 690° C. At this point the evolution was rapid. Further traces were seen when the temperature was raised to 700° C., but none were given off with any further rise. The first traces with ferrous sulphate appeared at 550° C.; the increase was slight up to 580° C. and more rapid until 600° C. was reached, when there was a sudden increase. On heating for two hours at this temperature decomposition was practically complete, for on further heating to 650° C. very slight traces of acid were indicated, and on further heating all reaction ceased.

The data so obtained are of value to the metallurgist and chemist, as they show the minimum temperature at which the furnace can be run for complete decomposition and the limits that should not be exceeded for producing the required results.

Melting Point of Slag.—At the January meeting of the Institution of Mining and Metallurgy, A. T. French read a paper describing experiments made to determine the melting points of slags such as are formed in the smelting of copper ores. The usual tables of fusibilities are confined to recognized silicates, and do not give particulars of the melting points of mixtures or of specific examples of slag. The results obtained by Mr. French are given in the following table:

Mark	Cu	Insol.	FeO	CaO	Al_2O_3	MgO	ZnO	Total	Seger Cone No.	Melting Point, °C.
A	0·1	38·7	23·1	21·2	11·4	4·3	0·4	99·2	—	1350+
B	0·15	40·0	21·3	19·9	10·8	5·5	1 5	99·15	7	1270
C	0·1	41·9	30·4	17·7	6·5	3·0	1·0	100·6	1	1150
D	0·28	41·9	28·3	16·0	9·1	3·0	1·0	99·58	5	1230
E	—	42·4	20·8	22·4	11·2	1·5	1·0	99·3	5	1230
F	0 23	43·8	22·1	20·0	9·7	3·2	1·75	100·78	5	1230
G	0·15	44·3	18·5	21·5	12 2	3 0	1·0	100·65	5	1230
H	0·15	45·0	20·5	17·05	10·0	4·8	1·8	99·3	5	1230
I	—	47·0	21·8	18·8	—	—	—	—	7	1270
J	0·1	47·3	19·2	17·5	10·0	4·7	2·0	100·8	11	1350

The temperatures of melting were ascertained by comparing with those of standard Seger cones. In the case of *(A)*, the first on the list, no sign of fusion was discernible at the temperature 1350°C, which was the temperature of the most refractory cone on hand at the time. This slag had the lowest silica content of the series, and it had a high alumina content. The most fusible slag *(C)* may owe its property either to the high iron content or the low alumina content. It would seem that there is a considerable range within which the slags may vary in composition without seriously altering the melting point. For instance, the silica may vary from 40 to 47%, the ferrous oxide from 18½ to 28%, the lime from 16 to 22%, and the alumina from 9 to 12·2%. If these limits, especially with regard to the silica and the silica plus alumina, are passed either way, the melting point rises.

This paper was severely criticized at the meeting. In the first place, the experiments were not sufficiently numerous to warrant any general conclusions and deductions. It was pointed out that the method of making the sample cones by crushing the slags fine and binding with 2% lime was not satisfactory, as the added lime would make a difference in the composition and consequent results; it would have been better to chisel a cone out of the hard slag to a shape similar to the Seger test-cones. Another objection is that information is not given as to the physical period when the temperature was taken; that is, whether it was when the cones commenced to fuse or when the whole mass was fully liquid. It was pointed out that a complex slag has no definite melting point, but exhibits signs of melting at intervals during the rise in temperature according to the melting points of its individual constituents. It follows therefore that a cone might show an inclination to fuse at a lower melting point than a standard cone of silicate and yet its complete fusion would be effected at a higher temperature than that of the cone. The results given in Mr. French's paper cannot therefore be considered conclusive.

Concentration of Copper Ores.—In the *Mining World* of Chicago for January 8, Leroy A. Palmer describes the new dressing plant of the Ohio Copper Co., at Lark, Utah. The mine belonging to this company adjoins that of the Utah Copper Co., and the little town of Lark is over the mountains from Bingham. The Ohio ore is different from that at the Utah and Boston mines, being chalcocite and chalcopyrite in a gangue of quartzite. The mineral occurs in larger grains in the quartzite and is not disseminated minutely as it is in the monzonite at the neighbouring mines. The two classes of ore have the points of similarity in being highly silicious and low-grade, the actual content of the Ohio ore being 1·75 to 2%. The Ohio plant commenced working in November, and is capable of treating 2250 tons per day. In designing the mill, provision has been made for its extension at any time so as to double the capacity. The method of concentration is naturally different from that at the neighbouring plants. The design presents some points of novelty. To the English and German reader it will be gratifying to find that the much despised buddle has found a place in an American dressing plant. The ore is first treated in jigs, and after grinding in Chilean mills is passed to James and Wilfley tables. The concentrate from these tables is sent to a set of 'finishing' tables, where without the formation of any waste product, it is separated into a concentrate lower in silica, and a middling, the latter being sent once more to be re-ground. The function of these finishing tables is to produce a concentrate from which as much silica as possible has been eliminated, without wasting any of the copper content. This system makes it possible to be less particular in reducing the silica content of the jig and table concentrates, and consequently decreasing the loss of copper in the tailing. The fine ore produced at various points is sent to a separate slime-house. Here it is classified and the coarser treated on Wilfleys. The slime goes to a series of single-deck buddles, 16 ft. diam., concrete-covered, and revolving in 72 seconds. It is too soon to give exact results and costs, but so far it appears that concentration is effected on a basis of 16 or 18 tons to one. The percentage of extraction is from 75% on 1·75% ore and 80% on 2% ore. The power for the mill is supplied by a current that comes at 40,000 volts from a power supply company at Bingham. The consumption when the plant is running at 2250 tons per day is approximately one horse-power for every ton of ore treated.

Studies in Amalgamation.—In our October issue we gave an abstract of G. O. Smart's paper read before the Chemical, Metallurgical, and Mining Society of South Africa, giving the results of investigations relating to the best interval for dressing the amalgamation plates of stamp-mills, his conclusion being that 12-hour intervals were the best. He gave further information on this subject at the November meeting of the Society, on which occasion he described the results obtained with the amalgamation plates of tube-mills. His general conclusion was that an 8-hour interval was the longest time that can safely be allowed between

Stamp-batteries in new mill of Mexico Mines of El Oro.

two dressings. The average results obtained in his experiments, which lasted over a period of 12 days, are given in the following table:

Hours after Dressing.	Extraction %	Mesh	Grading entering tubes	Grading leaving tubes
½	26·05			
2	29·27			
4	27·04	+0·01	59·97	16·80
6	25·01	−0·01	23·25	24·88
		+0·006		
8	23·87	−0·006	16·78	58·32
10	18·44			
12	17·77			

The individual results obtained in the experiments were irregular, and it was difficult to know how to average them so as to obtain satisfactory deductions. Eventually the author decided to discard the abnormal figures. A reason for the irregularity may be that amalgam is always present in the pulp discharged from the tube-mills, this being caused by mercury escaping from the battery plates and amalgamating with the gold during re-grinding. Acting on the results of these experiments, the author for some time adopted the 8-hour interval, but subsequently went back to the 6-hour interval. The reason for reverting to the old practice was that one-third of his stamp-mill is now running without amalgamation plates, and more work is being put on the tube-mill amalgamation plates. Owing to the somewhat inconclusive nature of the present experiments, it is expected that further investigations will be made.

Concentration at Bunker Hill & Sullivan.—The methods of concentrating the lead-silver ores at Cœur d'Alene, Idaho, have been entirely re-organized during the last few years, and modern tables for sand and slime have been introduced. The new plant at the Bunker Hill & Sullivan has just been completed and was put into commission on December 8. It is described by Gelasio Caetani in the *Mining and Scientific Press* for January 15. The ore consists of argentiferous galena in siderite and quartzite, the siderite predominating and averaging 40 to 45% of the ore. The lead content averages 10 to 13%, and there is 0·42 oz. of silver per unit of lead. One of the economic problems in connection with this ore is that the siderite becomes marketable when smelters are wanting a flux. In the new mill the motive power is supplied by electric current; and belt-conveyors, automatic feeders, and other labour-saving devices are used. The ore is sent to two classes of jigs, that between 30 and 10 m.m. to bull-jigs and the finer direct to classifying jigs. The bull-jigs have four compartments and the classifying jigs five. The first compartment of the bull-jigs gives a shipping concentrate assaying 50 to 55% lead. The second gives a concentrate running 35 to 40% lead, which is re-ground in Huntington mills and re-concentrated on Card tables; the tailing from these tables assays 5 to 8% lead, but it is so finely disseminated that a closer concentration is not economical. The third and fourth compartments produce middling which is re-crushed to 10 m.m. and re-treated in classifying jigs; here again the final tailing is high in lead that is irrecoverable cheaply. The hutch product is returned to the middling jigs. The tailing from the bull-jigs assays 1 to 1·6% lead.

The classifying jigs produce nine products: (1) The slime is eliminated in the first compartment by being floated through two lateral openings; it is then passed into spitzkasten for the separation of anything coarser than 200-mesh, and then to frue-vanners. (2) The first compartment produces high-grade concentrate assaying 60 to 65% lead. (3) The second compartment produces a concentrate containing 40% lead, which is graded in a similar way to that from the bull-jigs. (4) The third and fourth compartments produce a middling, assaying about 10% lead and 30% iron, which may either be sold as a flux or sent for re-treatment along with (5) the product of the fifth compartment, which assays 3 to 5% lead. (6) The hutches of the third, fourth, and fifth compartments go to rolls and then along with (5). The hutch of the first compartment gives product (7) assaying 50% lead, which is separated by means of a pipe-classifier into (a) a coarse product assaying 76 to 77% lead, and (b) an overflow that goes to a Card table. The efficiency of the pipe-classifier is due to the fact that the coarse particles are high-grade cubes of galena, while the finer particles are low grade. (8) The hutch of the second compartment assays 25 to 30% lead and is treated in the same way as (7). The tailing (9) assays about 1·3%.

It will be seen from the above that the whole of the ore passes through either one or other of the sets of jigs, and that four different products flow from them to be re-treated, namely, the low-grade concentrate to the grading department, crushed middling, hutch products, and sand to the sand-plant, the first and second hutch products to pipe-classifiers, and the slime

The material going to the sand-plant is ground so as to go through 22-mesh, and is then fed to 'duplex' classifiers of the spitzlutten type. These yield three products and an overflow, the latter being separated by cone-classifiers into fine sand and slime. The four products of classification are then sent to four sets of Card tables, where five products are obtained : (1) first-class concentrate assaying 76% lead ; (2) second-class concentrate assaying 45% lead, which is sent for grading on other tables ; (3) middling which is re-crushed and re-treated ; (4) tailing averaging 2½% lead ; (5) slime which goes to settling-tanks and vanners.

The capacity of the mill is 550 tons per day. It will be noted that no material is at any time sent back for re-treatment on the same machine. In this way the efficiency of all parts of the plant can be readily ascertained ; and another advantage is that by this system any faulty work of one machine may be corrected by another. No attempt is made to obtain a perfect extraction, and it is clear that the tailing content is high. The problem has been to make the best extraction at the lowest cost.

Chemistry in the Mineral Industry.—At the meeting of the Society of Chemical Industry held in London on January 3, George T. Holloway read a paper entitled : 'The relation between the mineral and the chemical industries.' The paper was a most comprehensive one and showed a wide range of knowledge on the part of the author. For this reason it is worthy of close study, but owing to its length we are unable to do justice to it in these columns. The title does not give quite a clear idea of the scope of the paper, though we are unable to suggest a short one that would do better. The paper consisted of a discussion of the chemical reactions that explain the formation of mineral deposits, and of the products due to the weathering of rocks, the reasons for the association of certain minerals, the production of rare minerals nowadays in demand, the treatment of complex sulphides, the weathering of auriferous ores, and the proposals for the prevention of waste of sulphur, fuel, and heat.

In the study of the weathering of rocks, the author took granite as a type and traced the reactions that formed various sorts of clays from this source, and dissolved the silica. In connection with the formation of china clay from granite he shows that something more than atmospheric weathering is required to explain the reactions, and attributes some of the change to the action of volcanic gases and vapours such as hydrofluoric acid and volatile fluorides, and boric, sulphuric, and hydrochloric acids, as well as superheated steam. The occurrence of fluorspar in conjunction with chinastone indicates that fluoric gases have been present ; and the occurrence of tin ore in conjunction with fluorspar in many of the Cornish tin mines has been attributed to the action of gaseous fluoride of tin coming up and being decomposed near the surface into cassiterite. These theories are favourable to the search for rare metals and minerals in the eruptive rocks and in the veins traversing them. For instance, the chemical examination of tailing in the Red River at Camborne shows the presence not only of tungsten but of uranium, vanadium, tantalum, niobium, and molybdenum. Chemists at some of the Cornish mines continually find difficulties in their analyses owing to the presence of these hitherto unsuspected metals.

Mr. Holloway gave some details relating to the colouring of fluorspar and quoted Richard Pearce's investigations into the effect of uranium in producing this colour. Mr. Pearce's views were expressed in 1861, long before radio-activity became a matter of general knowledge. Mr. Pearce and Mr. Holloway have recently been pursuing this question further, owing to it having been discovered that radium emanations have the power of colouring glass a deep purple. They discovered that if radium bromide is left in contiguity to colourless fluorspar, there is a perceptible change of colour within a few weeks and from this they deduce that the presence of radio-active substances plays a part in the colouring of minerals.

Coal Dust Explosions.—In 1908 the Austro-Hungarian Committee on Fire Damp determined to continue the researches undertaken some years ago on coal-dust from the Ostrauer and Rossitzer mines in Austria. The results of the first preliminary experiments are published in *Berg- und Hüttenwesen* No. 35, 1909, by Messrs. Czaplinski and Jicinsky. The object of this work was (1) to determine the conditions under which coal-dust in the absence of methane could explode, (2) to test various applied and suggested methods of weakening or preventing the explosion, (3) to test the efficacy of water spraying, of wet and dry dust-free zones, and of dry rock dust zones. Further researches on the effect of explosive gases are in course of completion. The work took place in an underground tunnel 320 yds. long, at one end of which a shaft 50 ft. deep slanted down to the explosion chamber, a shaft 10 ft. deep at the other end affording entrance. At distances of 115 ft. and 290 ft. from the chamber, tubes projected for conveying the coal-dust to the tunnel and rotary fans at these points ensured its thorough dissemination. The explosion chamber 4½ ft. by 5½ ft. by 6 ft. had also a tube for bringing in coal-dust, and a fan and a manometer measured the maximum pressure inside. To measure the length of the flame ordinary matches were stuck in the wall of the tunnel every yard and by examining the number burned after the explosion an estimate could be formed. The afterdamp was forced into a sample tube by the explosion and was analysed directly afterwards, different values being : CO_2 0·8 to 6·45% ; CO 0·3 to 3·2% ; oxygen 10·95 to 18·3%. The dust was collected from the coal-dressing plant at the mine so as to obtain the probable material met with underground and only the finest was used. Of the two varieties one left 3·8% on a 145-mesh sieve and the other left 19·2% on an 85-mesh ; chemical analysis gave : moisture, 0·58 to 4·5% ; ash, 9 to 17% ; volatile matter 19 to 33%. The effects of strong explosions were often very noticeable on the iron doors of the shafts, as they were bent and even blown high into the air. Dynamite and black-powder were used as detonators and they were fired electrically. Loose dynamite cartridges gave a flame length of less than one yard, the time of explosion being less than 0·015 sec. and the maximum pressure 1·3 atmosphere. It has been found difficult to record the variations in pressure due to the explosion with dynamite, as the first wave caused by the dynamite itself masked the feebler effort of the coal dust. Curves of pressure are given in the article. The first waves recorded are due to the explosion of the powder and the succeeding smaller waves are due to the coal dust, the latter pressure being about 0·4 atmosphere. Moisture has a great effect on the explosion. Thus dust with 2 to 4½% of moisture gave only a short flame, but the same dust with a moisture content of 0·8 to 1·7% gave under the same conditions a flame length of 147 metres. Water spraying for 10 to 15 metres in front of chamber reduced flames of 24 metres to zero, and flames of 130 metres were reduced by 30 metres.

COMPANY REPORTS

Pahang Consolidated.—This company was formed in 1906 for the purpose of amalgamating the Pahang Corporation, the Pahang-Kabang, and the Malay Exploration Syndicate. The properties consist of lode-tin mines situated in the State of Pahang, in the eastern side of the Malay peninsula. The management is in the hands of the Borneo Company. During the summer of last year it was found that the ore reserve had been greatly over-estimated, and that the condition of things at the mines was critical. Accordingly Reginald Pawle, chief engineer of the Borneo Company, was deputed to make a thorough investigation. The results of his examination are published in the company's report for the year ended July 31, 1909. He states that the ore reserve is limited and will not last for more than nine months, though owing to the irregular nature of the lodes it is quite impossible to give any idea of the content of the ore ready for stoping. His suggestions for bringing the company to a paying basis involve much development work, the erection of a power station, and the enlargement of the mill. Before going further the directors have decided to have the opinion of William Frecheville, who sailed for the East on January 7, for the purpose of making an examination of the mines. The directors' report contains the results of the operations for the year ended July 31, and details are supplied by H. E. Nicholls, the acting superintendent. The mill treated 53,856 tons of ore and produced 893 tons of black-tin concentrate. In addition 26 tons of alluvial black-tin were recovered, making the total output 919 tons, which sold for £79,576. Other revenue brought the total income to £81,893. The expenses at the mine were £75,653, London expenses £2379, interest on loans £4683, and loss on exchange £69, so that there was an adverse balance of £1891. The company also owns a rubber estate, which is on the point of being productive. An interesting item in the manager's report relates to the decrease of illness owing to the efforts during recent years to clear the jungle and improve sanitation.

Giant Mines of Rhodesia.—This company was formed by the Consolidated Gold Fields of South Africa in 1903 to acquire the mine of that name in the Gadzema district of Rhodesia, 65 miles west of Salisbury. During the years from 1906 to 1908 the mill gave excellent results on 10 dwt. ore, but unfortunately in August of that year the main shaft collapsed. The sinking of a new shaft some distance away was immediately commenced, and development was continued by the West shaft. During the past few months news has come to hand relating to the developments in cross-cuts started from the new shaft. The report of the company for the year ended June 30 has been published. Milling continued during the year, 65,690 tons of ore yielding 13,619 oz. gold. This recovery is less than in previous years, and the decrease is due solely to the fact that a large amount of waste and low-grade ore was treated. Circumstances in connection with ventilation made it impossible to extract much ore from the mine. The working profit was £16,971, and the net profit £3013. As £15,388 was brought forward from the previous year it has been possible to distribute £11,875 as dividend and carry £4150 forward. A year ago £50,000 6% debentures were subscribed for the purpose of sinking the new shaft and increasing the plant to a capacity of 12,000 tons per month. This plant is now ready to start. For the last four or five months, ore from the mine has been treated in the mill instead of waste and material from the open-cut, so that the monthly returns are improving. Developments at the mine are excellent, and the reserve of ore is large. The actual amount blocked out is given by H. A. Piper and A. J. Fraser, the engineers, at 204,846 tons valued at 10·4 dwt., but at the shareholders' meeting it was announced that there are also extensive bodies of ore likely to contain anything from half to a million tons.

Naraguta (Nigeria) Tin Mines.—This company has been formed to purchase the Naraguta mine from the Niger Company. The promoters are the Champion Gold Reefs of West Africa, and the board of directors contains the names of F. N. Best, John Waddington, H. C. Godfray, and H. J. Moir. The capital of the company is £175,000, of which £115,000 in shares is purchase price, and £60,000 has been subscribed in cash as working capital, the promoters and the Nigeria Tin Corporation putting up substantial sums. The property acquired consists of five square miles of alluvial land in the Bauchi province of Northern Nigeria. It has been worked by the Niger company in a primitive method for two years or so, and is yielding one ton of black tin per day. With slight expense, this output could be easily doubled. Up to the present time one square mile has been prospected by pits and it is estimated that it contains at least 9000 tons of black tin. The question of working the ground by modern dredging plant is under consideration. Before long many other tracts of land in Bauchi province will be developed by the present promoters in conjunction with other financial houses, and Nigerian tin will become an important feature of the African mining industry.

Associated Northern Blocks.—This company is under the same management as the Associated Gold Mines of Western Australia, and the property is situated at the northern end of the golden mile at Kalgoorlie. Hermann Landau is chairman and George M. Roberts is general manager. The report covering the year ended September 30 shows that no improvement has taken place in the prospects of the mine. It is not possible to give exact figures for the reserve, but the manager considers that there is sufficient ore left to keep the mill profitably occupied during the current financial year. It is not for want of prospecting that no new orebody has been found in depth; quite 500 ft. below the lowest ore, 1050 ft., has been drilled with no result. The ore treated during the year was 44,163 tons yielding 17,726 oz. gold. In addition 11,805 tons of accumulated slime yielded 1442 oz. The total value of the output was £81,509. The net profit was £20,823, out of which £17,500 is being paid as dividend, being at the rate of 5%. Owing to the impending exhaustion of the mine, the directors are anxious to secure other properties. Examinations have been made in Australia and in Central America, but no option has so far been exercised. Since the company commenced operations in 1899 the total output of gold has been to the value of £1,479,321, and the dividends distributed have amounted to £682,000 on £350,000 nominal capital. The present financial position of the company is a strong one, for there is a reserve fund of £128,757 invested in Government securities.

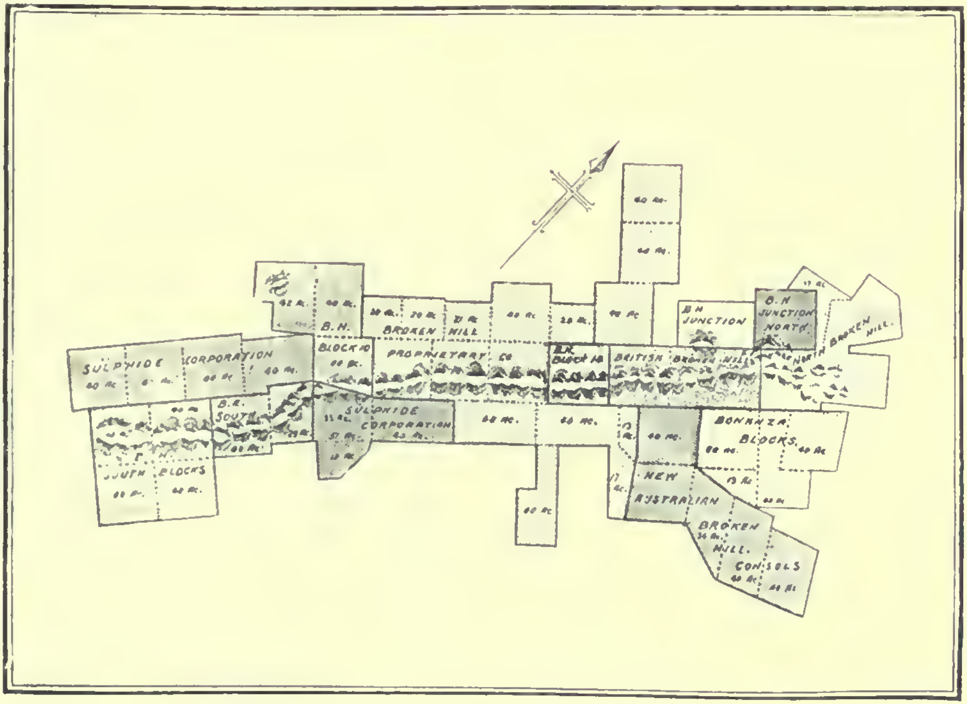
Oroya Black Range.—This company was formed in 1906 to acquire property in the Black Range district of the East Murchison goldfield, West Australia, and was floated by the controllers of the Oroya Brownhill company. Bewick, Moreing & Co. are the general managers, H. C. Hoover is on the board, and James Brothers are consulting engineers. Milling commenced in July 1907 and the first dividend was declared in July 1908. The present report covers the year ended August 31 last. Twenty stamps are at work, together with cyanide plant for sand and slime. During the year 53,703 tons were milled, yielding 18,907 oz. by amalgamation. The sand plant treated 33,705 tons and produced 7110 oz., and the slime plant treated 19,998 tons of current and 1004 tons of accumulated slime and produced 5794 oz. The total production was therefore 31,811 oz., valued at £135,117, a yield of 50s. 4d. per ton milled. The total extraction is high, being as much as 96·6%. On August 31 the ore reserve was estimated at 107,000 tons, of which half contains 50s. and the remainder 40s. The development during the year has hardly kept pace with the mill, and the ore at present being opened up shows some decline in content. It will be noted also that the cost of working is high compared with the figures shown at other West Australian mines. This is accounted for chiefly by the lack of railroad communication. The cost at the mine during the year was 83,760, and £17,215 was written off for mine development and depreciation. After London office expenses and taxes had been paid there was a balance of £27,323. Adding this profit to the balance brought forward from last year the amount available for distribution was £46,734. Out of this £29,983 has been paid as dividend, which is at the rate of 15% on the share capital issued, £199,890. The total distribution since the commencement is therefore 4s. per £1 share. The directors admit that the present performance of the mine is not as good as was expected, but developments, though they disclose ore of lower grade, seem otherwise hopeful, and when railway communication reduces costs, the profit ought to be fairly well maintained.

Gaika Gold.—This company was formed in 1902 to acquire the Gaika mine in the Sebakwe district of Rhodesia. The mine had been developed and partly equipped by the parent company, the Rhodesia Exploration and Development Company. Alexander Davidson, Hans Sauer, and Sir John Willoughby are directors; H. E. Jones is consulting engineer, and P. A. Cockburn is manager. Milling commenced in August 1905 with 5 stamps and a Chilean mill, and subsequently a cyanide plant was added for treating sand. The report for the year ended June 30 shows that the plant crushed 34,156 tons, a rate of 23 tons per stamp per day. The extraction by amalgamation was 12,458 oz., or 7·29 dwt. per ton. The cyanide plant treated 70,023 tons of sand and produced 1324 oz., or 1·32 dwt. per ton. The cyanide residue contained 0·6 dwt. At the present time the slime is not being treated and the content, 1·47 dwt. per ton, is therefore not being recovered. The total assay value of the ore was 9·01 dwt. The value of the production during the year was £57,822; the working cost, including development, was £34,446, so that the net profit was £23,884. In addition £3827 was spent on capital account and £13,415 has been applied to the reduction of the development account. No dividend has yet been paid. The capital of the company is £204,757 in shares and there are £35,000 debentures. As regards future prospects Mr. Jones shows that 3254 ft. of development during the year has materially added to the ore reserve, which on June 30 stood at 32,000 tons averaging 15 dwt. The workings are not down farther than the 244 ft. level, and one of the shafts will be shortly carried down another 100 ft. As regards the accumulated slime, steps will be taken shortly to devise a method of treating them.

Tasmania Gold Mining.—This company was formed in 1903 by John Taylor & Sons to acquire the properties belonging to a local company at Beaconsfield, Tasmania. These mines had been successful gold-producers, but owing to the increase of water in depth, the continued working of the mine involved a far greater expenditure on pumping plant than the local owners could afford. This capital was provided by the flotation of a London company, and the plant laid down is one of Henry Davey's best examples of modern Cornish pumps. Additional capital was also provided for systematic development in depth and for improved mill-equipment. The mining difficulties have been greater than were expected, and the mine has not yet arrived at the dividend-paying stage. The production of gold for the years ending September 30 from 1905 to 1909 have been £130,442, £139,147, £129,894, £128,647, and £92,767. The drop shown by the figures for the year ended September 30 last is accounted for chiefly by the fact that operations were suspended during parts of July and August owing to renewed difficulty with the water. At the 1250 ft. level an unexpected volume of water entered and rapidly filled the lower workings. At the higher levels water was encountered at three different points, and it was expected that similar circumstances would exist at the lower levels. As a matter of fact, at the 1250 ft. level the water all came in at one place and upset calculations. The decreased production is also partly due to the poorer quality of the ore mined recently. Fortunately the developments at the 1250 ft. level point to a general improvement, and already the lode has been uncovered for 715 ft. averaging 5 ft. in width and assaying 12½ dwt. During the year ended September 30, 53,789 tons were milled, yielding 17,943 oz. by amalgamation; chlorination, cyanidation, etc., brought the total output to 21,851 oz. The receipts of the company from all sources were £93,168, and the expenditure £95,462. After allowing for depreciation, taxes, etc., the debit balance at the end of the year was £22,825. The expenditure charged to capital account during the year on buildings, machinery, and plant was £13,366. A new plant has been erected for the treatment of accumulated concentrate and slime, consisting of roasters, amalgamating pans, and cyanide plant. The amount awaiting treatment contains 20,966 oz. gold and approximately 75% will be extracted. The cash assets on September 30 were £18,802, and in face of the adverse results of the year's working the situation is not altogether encouraging; but with the improvement in depth and the forthcoming income from the accumulated concentrate, the company should soon win an improved position.

Le Roi.—The report of the Le Roi Mining Co. for the year ended September 30 last shows that this British Columbia gold and copper mine is not now shipping ore, but that operations are centred on exploration by diamond-drilling. Two years ago W. A. Carlyle visited the mine, which had then come under English control, and he elaborated a system of exploration and development. He paid another visit in February 1909, but found that the results obtained were not encouraging, and he advised that mining and smelting should be suspended. Subsequently, in August, work was resumed at the mine with a view of exploring by diamond-drill in several directions, including deep drilling to 2650 ft. So far two finds have been made on the 600 ft. and 1200 ft. levels respectively, and cross-cuts are now being driven to reach them. During the year under review 26,935 tons were mined, averaging 12·8 dwt. gold, ⅓ oz. silver, and 0·85% copper, equal to $15·48 per ton. This amount is only a quarter of what was raised in the previous year. The cost of mining and smelting was $15·23 per ton. At the Northport smelter 38,958 tons were treated, producing matte and clean-up material amounting to 1175 tons, which brought $678,575. The smelter was closed on April 28 As £20,712 was spent on exploration and development, and £10,378 was written off for depreciation of plant, the year ended with an adverse balance of £9701. The year commenced with a balance in hand of £89,032, so that the balance to credit of profit and loss on September 30 last was £79,331. The directors are now waiting for the result of the present exploratory work, upon which depends the future of the company.

Broken Hill Block 14.—The report of this company for the half-year ended September 30 has been issued. Mining operations are still confined to the extraction of carbonates from the upper levels, and during the six months 12,194 tons averaging 31·97% lead and 10·63 oz. silver were raised and sold to the Proprietary Company. This output compares with 10,253 tons of similar ore during the previous half-year. Development work has continued to open up carbonate ore and on September 30 there was at least 10,000 tons available for stoping. Though there are still some unexplored parts that are likely to add to the resources of the mine, it is gradually becoming more difficult to find ore suitable for shipment Development consists mainly of short winzes and of the extension of stope-floors into ground that sometimes lays bare old workings, so that operations have to be conducted slowly and carefully. The sulphide ore is not being worked, as it is too poor to pay at present prices. Prospecting work by diamond-drilling has been done, but nothing of value has been found, so that the reserve remains at 220,000 tons averaging 12% lead, 8½ oz silver, and 9% zinc. There seems to be no probability of the orebody extending below the 600 ft. level, although there are much deeper workings in many mines on the Barrier Range. The directors consider that the maximum figure for the sulphide ore will be 300,000 tons, and in view of these facts they are contemplating the desirability of acquiring some other property. With regard to the concentration of these sulphides, the directors have been in negotiation with the Murex Magnetic Co. and at the present time arrangements have been made for the erection of an experimental plant at the mine. As regards the financial results for the half-year in question, the sale of ore brought an income of £20,863, and the expenses were £21,740. The preference dividend required £1500 and there were other small items in the accounts, making the final debit balance £1539. The half-year commenced with £79,327 in hand and ended with a balance of £77,788. Within the last few months the companies at Broken Hill have suffered from shortage of fuel due to the coal strike, and some have had to close down in consequence. Block 14, however, has a fair stock in hand, and its requirements are not large.



PLAN OF THE BROKEN HILL MINES, NEW SOUTH WALES.

Broken Hill Block 10.—The report of this company covers the half-year ended September 30 last. The mine and plant were worked for only 16 weeks out of the 26, as the labour troubles that caused a cessation of work during the previous half-year were continued until June. The output was consequently restricted ; 40,450 tons were raised, as compared with a usual half-yearly average of 70,000 tons. The lead concentrate produced weighed 6712 tons assaying 60·26% lead, 9·08% zinc, and 34·18 oz. silver. This was a recovery of 41·17% of the lead and 73·98% of the silver contained in the ore The tailing assayed 1½% lead, 19·1% zinc, and 9·2 oz. silver. Hitherto the company has not treated the zinc tailing and slime, but has sold them elsewhere During the half-year, 76,000 tons of slime and 12,500 tons of zinc tailing have been sold at 7s. 6d. per ton It has recently been decided to start treatment on the spot, and an Elmore plant capable of handling 800 tons per week has been ordered. The directors have acquired other properties, which are on what may be the southern extension of the Broken Hill main lode. In former years some work was done on these properties and in one of them, the Rising Sun, there is a shaft 500 ft. deep. At one place a lode 5 ft. wide was exposed for a distance of 165 ft., showing 13·8% lead, 3·4% zinc, and 2·4 oz. silver. Arrangements are now being made thoroughly to investigate the property again. As regards the financial results of the half-year, the lead concentrate brought £47,482, and the expenses at the mine were £40,978. The amount credited to revenue from the sale of zinc tailing was £23,735. The dividend distributed was £20,000, being 2s. on each £10 share. Since the date of issuing this report the mine has had to close down once more owing to the short supply of fuel consequent on the coal strike.

Wheal Kitty and Penhalls.—The report for this company, which operates tin mines in St. Agnes district, Cornwall, covers the half-year ended December 31. The mine is a small one, but it contains good ore and is skilfully and economically managed. The results for the half-year are practically the same as those obtained during the previous half-year. The ore raised was 6322 tons and the black-tin concentrate sold was 121 tons. These figures compare with 6028 tons and 120 tons during the first six months of the year. The amount realized was £10,518, or £85 per ton of concentrate, as compared with £9990 and £83, and the profits were £2386 as compared with £2601. A dividend at the rate of 7½% per annum absorbed £977, and £1174 was written off for depreciation, etc. The amount of development during the half-year has been 1462 ft., or one foot for every 4⅓ tons of ore sent to the mill. During the last few years much of the profit has been applied in developments, sinking the new shaft, and providing pumping and other plant. The amount of capital spent during the half-year for the same purpose was £3599. The report of the general managers, J. H. Collins & Sons, shows that the developments are highly encouraging. Some new exploration work on the Flat lode near the southern boundary has disclosed ore 18 to 30 in. wide and averaging 50 lb. of black tin per ton. This discovery is important, and the directors have acquired the Gooninnis sett adjoining on the south, as they anticipate developments in that direction.

Oonah Mines.— These mines are situated on the west coast of Tasmania about half a mile north-west of Zeehan. They were originally worked for silver and lead, yielding large profits. More recently another lode consisting of stannite, that is, sulphide of tin and copper, was discovered. Though this ore contained over 20 oz. silver and over 4% of both copper and tin, the price obtained was not good enough and the mine had to be closed. This is a comparatively rare ore, and the method of treating it profitably has been known hitherto only to a few of the older smelting firms. In former days Cornish and other ores containing cupriferous pyrite and cassiterite that could not be separated by hand-picking were smelted at Swansea, but the mines had to be satisfied with payment for only one of the metals. The Oonah mine was eventually acquired by the Mount Lyell Comstock Co. and floated as a separate company a year ago, after Alexander Hill & Stewart had made an exhaustive examination. They found the veins extensive, but varying in width and irregular in occurrence. On a conservative estimate they calculated that there was 10,500 tons ready for extraction assaying 22 oz. silver, 5·44% copper, and 4·60% tin. In order to extract this amount, more rock would have to be mined in some places, owing to the irregularity of the deposits, but on the other hand the ore could be easily sorted and a shipping ore picked out that would probably exceed the above estimate. There was every reason for expecting the veins to continue, but before proceeding with development it was deemed best to devise a system of metallurgical treatment. Accordingly a shipment was made to England and both smelting and wet methods were tried. Eventually it was found possible, by aid of a roaster and reverberatory, to make two products : (1) a copper-silver matte and (2) an argentiferous copper-tin alloy. These are marketable, but buyers will not pay for the tin in the matte nor for the silver in the copper-tin alloy. The subsequent history of the venture is contained in the report of the company for the year ended June 30, and in Alexander Hill & Stewart's report dated January 18 of this year. A smelting plant was erected near the mine consisting of a roasting-furnace and a reverberatory, together with a blast-furnace for the treatment of the tin slag from the reverberatory. Experience gained by trial runs induced Mr. Stewart, who was in charge of operations, to modify the policy and to treat the ore direct in the blast-furnace, using the reverberatory for the refining of the copper-silver matte only. This alteration involved the adoption of pot-roasting. Experiments were therefore made at the Mount Lyell and the Tasmanian Smelting works, with gratifying results, the cost of the operation being less than 3s. per ton. The trial runs at the blast-furnace showed that bottoms containing from 39 to 49% tin, 0 to 17% copper, and about 250 oz. silver, could be produced, together with copper-silver matte averaging 8·2% copper, 5% tin, and 30 oz. silver. The blast-furnace product also contained from 7 to 19% bismuth and varying amounts of iron. The slag produced contained from 0·1 to 0·2% copper and 0·4 to 0·55% tin. Efforts were made to produce a matte less in quantity but of higher grade, but though this alteration had the advantages of using less flux and producing cleaner slag, it was open to the objection that much tin was lost by volatilization. By adopting pot-roasting, it has been possible to eliminate fine crushing and roasting, and the cost of operations has been slightly reduced. It is estimated that 50 tons of ore will be treated per day in the blast-furnace, and that the profit should be at least £4500. Unfortunately the smelter is at present idle, owing to the New South Wales coal strike having cut off supplies of fuel.

Wolhuter.—This mine is situated on the outcrop in the centre of the Rand and belongs to the Neumann group. S. C. Thomson is consulting engineer and A. R. Robertson is manager. The company was originally formed in 1887 and milling began in 1888. A reconstruction took place in 1895, when additional property was purchased and a new mill erected. A dividend of 10% was paid in 1894 on the capital of £130,000, and the only other dividend has been 20% during 1897-8 on the present capital of £860,000, until for the year covered by the present report, November 1, 1908, to October 31, 1909, when a dividend of 5% was paid. The reason for this lack of profits has been the low grade of the ore, and it is only recently that the prospects have brightened by the general reduction of mining costs. During the year under review 331,553 tons were mined, and after sorting 280,120 tons were milled in the battery consisting of 120 stamps ; the yield was 46,443 oz. valued at £174,734. The assay-value of the feed was 6·65 dwt. and the yield was 3·316 dwt. per ton milled. The sand plant treated 193,920 tons and produced 30,617 oz., and the slime-plant extracted 6625 oz. from 86,200 tons. The sand-residue contained 0·744 dwt. and the slime-residue 0·341 dwt. The total income from the sale of gold was £350,754 and the mine expenses were £239,382. Out of the profits £48,857 was spent on capital account, and this, together with London expenses, brought the available profit down to £51,394. The dividend of 5% absorbed £43,000. During the year the working cost has been reduced from 19s. 4d. to 17s. 7d., and the tonnage increased from 255,750 tons to 280,120 tons; in this way an increase of £25,304 was made in profit. The plant has been increased during the year by two tube-mills, but these are not sufficient for the purpose and two more will be installed before long. The ore reserve is calculated at 436,635 tons valued at 6·29 dwt. over a stoping width of 49·8 in., and there are other blocks of lower grade ore classed as "unpayable." It is of interest to note that this mine has never had any serious labour trouble. It was always popular with the natives; so much so that it was not necessary to employ any Chinese.

El Rayo Mines. — These gold and silver mines are situated at Santa Barbara, in the State of Chihuahua, Mexico, and are owned by the El Rayo Mines Co., a New York corporation of which William B. Thompson is president. George A. Schroter is consulting engineer. This company was formed in February 1906, on which date it acquired the El Rayo and the Descrubidora properties. Subsequently, in July 1907, the Buena Vista properties were bought. All these mines had been extensively worked previously by local

The State of Chihuahua, Mexico.

owners. The new plant commenced operations in May 1907. The ore is crushed by rolls in cyanide solution, from whence it goes to Huntington mills, and Australian grinding pans. After treatment on frue vanners for the removal of pyrite, the pulp is classified into sand and slime. The relative value of the precious metal content is 85% of gold and 15% of silver. According to the report for the year ended October 31 last the ore milled was 43,008 tons and the yield was bullion and concentrate valued at $507,455. The assay-value of the ore was $13·03, and the extraction $11·80. The expenses at the mine were $341,728, leaving an operating profit of $165,726. Administrative and other expenses were $28,637, so that the net profit was $137,088. This sum, however, makes no allowance for depreciation. The main vein is from 2 to 20 ft. wide and extends for 7000 ft. The ore occurs in large irregular lenses along the vein, and the precious metals play out and come in again at distances of 50 to 200 ft. above or below the stopes. The development is done by adits and drifts. As regards the reserve, Mr. Schroter estimates that on November 1 last the ore blocked out on at least three sides was 50,000 tons, having a gross value of $785,000, and at several points the orebodies appear to be persistent.

Taquah Mining & Exploration. — This company operates the Taquah mine and owns a share in the Abosso company, which works the mine of that name in another part of the Tarkwa banket reef, West Africa. Both mines are under the management of G. A. Stockfeld, to whom is due the chief credit of having brought West African gold mining through troublous times to a successful issue. Certainly nobody has been more persistent and optimistic. It is not too much to say that his success at the Taquah and Abosso was the chief reason for the South African houses taking an interest in the district. The report of the Taquah company covers the year ended June 30 last. From this it is seen that operations have been considerably impeded by scarcity of labour, for the mill was not able to run more than 67% of its capacity. The amount of ore treated was 56,793 tons, and the production in the mill and cyanide plant was 37,197 oz., realizing £157,904, being an extraction of 13·09 dwt., or £2. 15s. 7d. per ton. During the early months of 1909 the mill ran below its capacity, but since the close of the financial year conditions have greatly improved. Under the circumstances it has not been possible to reduce the cost to the extent contemplated, and naturally the profits have been less than if the mill had been at work continuously. The mining cost was £111,555, and £18,457 was allowed for redemption of development account. After paying London office and other expenses, a balance of profit of £24,381 was made on the year's work. The sum of £22,859 was written off for depreciation, and on the other side of the account there is the additional income of £12,000, being a dividend of 10% on the company's holding in the Abosso Co. The company began the year with a balance in hand of £56,748, and £38,747 has been distributed to shareholders and holders of income bonds, being at the rate of 10% on both classes of holding. The sum of £13,971 is carried forward. Mr. Stockfeld reports that during the year under review the development work has consisted chiefly of sinking another shaft to the south of the main shaft and making the necessary connections between the two. He intends to commence a third shaft to the north and to work the three conjointly. At the present time only 40% of the length of the lode has been exploited, but with the three shafts the entire length will be opened up. The main shaft is now down 1096 ft., and the 6th and 7th levels are being developed. The ore reserve on June 30 was estimated at 141,187 tons averaging 15·6 dwt. The company has sold its dredging rights on the Ancobra river to the newly formed Ancobra Exploration & Dredging Co. During the year Arthur Wilkinson paid a visit of inspection to the Taquah and Abosso mines and reported in flattering terms on the mines and the method of development.

Abosso Gold.—The property belonging to this company is at a short distance from the Taquah, the Abbontiakoon and Fanti mines being in between. The report for the year ended June 30 shows that 60,702 tons of ore yielded by amalgamation and cyanide

32,607 oz. of gold to the value of £138,466, the extraction being 10·74 dwt., or 45s. 7d. per ton. Trouble has been experienced at this mine as well as at the Taquah owing to the shortage of labour. Rock-drills had to be used for stoping and close sorting was impossible, so that the average ore sent to the mill was of lower grade than it would have been had more labour been available. Also some repairs had to be made in the battery foundations. These two causes made the output of the plant less than usual. Since the end of the year covered by the report, better labour supplies have been obtained, and the output, costs, and profits are normal. The mine is opening up well, and the reserve on June 30 was 350,888 tons of milling ore averaging 14·4 dwt. The main shaft is down 1379 ft. and the vein is strong and continuous on all the levels from the 6th to the 9th. The tenth level at 1300 ft. has been commenced, and is giving good results. The prospects are so good that Mr. Stockfeld has recommended doubling the number of stamps from 50 to 100, the new stamps to be 1500 lb. in weight as compared with 1250 lb. in the present mill. The enlarged plant will then treat 200,000 tons per year. In order to provide the necessary funds 50,491 shares have been issued at 41s. each and sold among the present shareholders. It has been decided to erect a slime plant, and experiments are being made in regrinding with a view of increasing the capacity of the plant. During the year under review the cost at the mine was £81,861, and £13,657 was charged against development. The allowance for depreciation, etc., was £13,246, and taxes absorbed £5459. The dividends paid have amounted to £54,950. The outlook for this company is excellent, and the only cause for anxiety is the supply of labour. However, as the association for recruiting has been formed and the active support of the Government has been given, this disadvantage will be overcome.

Ouro Preto.—This company owns the Passagem mine in Minas Geraes, Brazil, and was originally formed in 1884. The management is in the hands of John Taylor & Sons. A. J. Bensusan is superintendent and R. H. Kendall metallurgist. The ore is comparatively low-grade, and the yield is about £1. 7s. 6d. per ton. The process of extraction consists of catching free gold on blankets, concentrating on frue vanners, and cyaniding the concentrate. Within the past two years the sandy tailing from the vanners has been cyanided; the average content is only 3s. 6d. per ton, and about 2s. 6d. is extracted at a cost of 6d. per ton. Plant has also been erected to treat the slime-tailing and it started operations in June 1909. During that month 1300 tons was treated and the extraction was 7s. 2d. at a cost of 1s. 11d. per ton. The report for the year ended June 30 last shows that during the year, 73,166 tons of ore yielded 25,050 oz. bullion realizing £100,609. The total cost was £88,627, and the profit (including £1206 interest, rents, etc.) was £13,188. Owing to extra expenditure on plant required to cope with an unexpected increase in the water entering the mine, and also on the new slime-plant, it has been necessary to curtail the amount of dividend. The preference shares receive £3663, which is the usual 10% on £36,334, and the ordinary shares, of which there are 100,000 of £1 each, receive £2500, or 2½%. In spite of the trouble caused by the increased inflow of water, development work has been well maintained, in fact the ore reserve is rather higher than the year before. The figures at June 30 were 202,030 tons, and in addition there were many blocks that could be called 'probable' ore. Stoping is done at several levels, especially at 315 metres, 470 metres, and 680 metres. Prospecting and development work has been carried down to 1028 metres, but the best discoveries recently made have been in the levels that have latterly been yielding the most profit. Mr. Bensusan in his report refers in a kindly way to the neighbourliness of George Chalmers, manager of the St. John Del Rey mine in the same district, and makes public recognition of the way he came to the assistance of the Ouro Preto mine when the unexpected inflow of water threatened to fill all the workings. Mr. Chalmers' action in lending pumping plant prevented what might have been a prolonged cessation of operations.

Exploration Company.—The report of the Exploration Company covers the year 1909. R. T. Bayliss is the chairman and managing director. The gross profits for the year were £85,894, and after deducting general expenses, the net profit was £62,368 Out of this a dividend of £56,250, at the rate of 7½% is being paid. The directors report that the company retains its investments in real estate at Johannesburg and a substantial interest in the shares of copper mining companies. It holds a large interest in the shares of the Mexican gold mining companies with which it is identified, and also in the Suchi Timber Co. at El Oro. The Exploration Company of England and Mexico, formed last year with a capital of £250,000 to conduct a systematic scheme of mining exploration in Mexico, has been actively engaged in the examination of mines and has secured working options on three properties.

New Modderfontein.—This company, belonging to the Wernher Beit group, has issued a circular in which the proposed policy of expansion is outlined. The company owns an extensive tract of country in the eastern part of the Rand, and we gave full particulars of the operations in our issue of November last. Since then the company has acquired certain other claims which, though limited in extent, have the advantages of containing deposits of rather higher gold content than the average of the property, and also of enabling connections to be made between the western, central, and eastern workings. The recent developments in the eastern section have been so satisfactory that the directors have decided to recommend a great increase in the scale of operations. The present plant is to be completed so as to be able to treat 52,500 tons per month, with a possible further enlargement to handle 91,500 tons. An electric installation is to be built and the whole of the plant is to be electrified. Development work is to be pushed forward in order to accumulate an ore reserve of 5,000,000 tons within two years, and to prepare underground workings in such a manner as to make it possible to mine and hoist large bodies of ore at a cheap rate. It is calculated that the total cost of this work will be £550,000, and in order to raise the necessary capital 50,000 shares of the nominal value of £4 are to be offered to shareholders at £11. The whole issue has been underwritten, at a commission of 5%, by H. Eckstein & Co.

Mount Lyell Comstock.—This company was formed in June 1907 to acquire the mine of that name in Tasmania. Though it has been worked for a number of years, the mine has not hitherto proved successful owing to the character of the ore. It was originally in the hands of a local owner, and was acquired by an English company in 1898. On reconstruction and the formation of the present company in 1907, Alexander Hill & Stewart were asked to examine and make suggestions as to exploration work. The present report, for the year ended September 30 last, describes the results so far obtained. One of the bore-holes made by diamond-drilling has indicated the presence of two promising orebodies. At one place the core assayed 2·9% copper over 20 ft., and at the other (100 ft. deeper) the length of core was 9 ft. 6 in. and averaged 7½% copper. Development is now in progress with the object of finding and exploring the orebodies thus indicated. Other parts of the mine have been further examined and additional information gained. At the present time the known orebodies in various workings are estimated to contain 168,000 tons assaying 2·57% copper. As regards the new orebodies, the indications given by the boring and by recent development work are that there is an orebody of 75,000 tons, and that other substantial masses will be found as well. The chief trouble hitherto has been that the ore exposed has been silicious, and could not be concentrated or smelted direct at a profit. The ore that has more recently been disclosed is less silicious. Concentration is to be tried on small parcels experimentally by means of various modern processes, and, to provide against delay should these fail, a study is being made of direct smelting. A year ago the company floated the Oonah mines, particulars of which are given elsewhere.

Goldfield Consolidated.—It is the proud boast of the Goldfield Consolidated Mines Co. that it operates the premier gold mine of the world. The gross assay-value of the ore produced during the year 1909, according to the company's report just issued, amounted to $7,386,450, from which was realized a recovery of 92 5%, or a total of $6,832,652. This was the return from 194,479 tons of ore, which therefore averaged $37·98 per ton gross. The total operating expense was at the rate of $6·77 per ton, making gross expenses of $1,572,251. The net profits were $5,026,619, out of which was made a dividend distribution of $5,000,000, or $1·40 per share.

The Combination mill, of 20 stamps, was injured to such an extent by the cave of the Hampton stope that it ceased operating on September 25. Interest chiefly centres, however, in the new Consolidated 100-stamp mill which was placed in commission on December 26, 1908. Additions and betterments throughout the year gradually increased the tonnage treated until, by October, a steady average capacity of 649 tons per diem was attained, with a milling cost of $1·915 per ton, and an extraction of 94·49% of the gold content. The average value of the ore sent to mill was $33·45, so that, on an average extraction for the year of 92·66%, the tailing carried $2·45. The concentrate-plant took care of 7005 tons, yielding a return of $2,728,185. The cost of treatment was $6·50 per ton. The concentrate is passed over amalgamating plates on its way to the cyanide plant. J. H. Mackenzie announces improvements, as a result of his own experiments in the refining of the cyanide precipitate, which will enable the company to produce bullion 990 fine, at a decrease in cost. The concentrate-treatment plant has been in operation since March, and is saving $25 per ton over the previous cost of marketing this product.

The report gives an analysis in detail of operating costs and is instructive as an example of reduction of expenses at a rich mine, a feat always more difficult of achievement than the repression of large expenses at a property that yields low-grade ore. The cost of stoping was $2·38, transportation 10c., milling $2·30, and development $1·56 per ton. The high ratio of development to stoping bespeaks the earnest effort of the management to procure reserves giving demonstrable longevity to the operation of the mine. In this connection it is to be noted that the output is a little less than 200,000 tons per annum, while the ore reserves are estimated at 800,000 tons. This accordingly represents a four years' supply, which is as close as any well ordered mine should run. Returning to the costs it is interesting to see the distribution of the total:

	Per ton	Total
Labour	$2·81	$533,776·81
Supplies	2·15	407,060·03
Power	0·41	76,271·74
Department	0·55	106,097·08
Construction	0·10	19,095·24
General expense	0·32	57,769·77
	$6·34	$1,200,071·27

In the matter of ore production the following credits to the several mines of the group are given:

	Tons	Average Per Ton	Gross Value
Combination	64,537	$52·24	$3,371,613
Mohawk	78,520	30·22	2,373,182
Red Top	48,894	28·46	1,391,756
Clermont	2,529	98·82	249,899
Total	194,480	$37·95	$7,386,451

In the Mohawk much ore is still left in the old lease-blocks, and stopes of large size have been opened between the 450 and 600-ft. levels, the ore being richer than in any other portion of the Mohawk workings. The 'glory hole' of the Combination is being extended in length, and rich ore has been revealed on the 230 and 280-ft. levels. The Hampton stope has a maximum width exceeding 70 ft. and, in addition to the high-grade milling ore, it produced 1193 tons of shipping ore having a gross assay-value of $684·38 per ton. Further development indicates that the Combination vein at a depth of about 300 ft. joins the Mohawk vein and dips rapidly away from the Combination shaft. Hence it is not anticipated that the known orebodies extend downward in the vicinity of this shaft below 380 ft., the present deepest level. The Red Top shows a large increase of ore reserves. The Clermont shaft in the Jumbo has reached a depth of 1050 ft. On the 750 and 900-ft. levels the downward extension of the Mohawk ore-shoot is being successfully developed for a length of 300 ft. On the 750-ft. level for 100 ft. the ore has averaged $450 per ton, and the average outside this richer zone is $30.

Within the year changes have been made in the organization, whereby the Goldfield Consolidated Mines Co., from being a mere stockholder, succeeds to actual ownership of the Goldfield Mohawk, Red Top, Jumbo, Laguna, and Goldfield companies. The details of the financial arrangements are given in the report, and constitute instructive reading. To enable the company better to transact its business the mining, milling, and transportation branches have been segregated by the organization under the laws of Wyoming of the Goldfield Consolidated Milling & Transportation Co., putting the railroad, water, and milling departments under management distinct from the mines. This admits of making a depreciation charge, effecting a reduction in the amount of bullion-tax that would otherwise be collected. The new company has a nominal capital of $400,000, divided into $100 shares. Commencing the year with a cash balance of $786,188, the parent company has completed its mill, extended development work, perfected its general plant, purchased proprietorship in the subsidiary mines, paid dividends, and begins the new year with a cash balance of $1,365,324. It has, furthermore, bullion and concentrate in transit amounting to $479,341. The general manager is J. R. Finlay, who recently succeeded J. H. Mackenzie, now consulting engineer to the company.

BOOKS REVIEWED

VAN NOSTRAND'S CHEMICAL ANNUAL. Second issue, 1909. Edited by J. C. Olsen. Cloth, 8vo. 592 pages. New York : The D. Van Nostrand Co. ; London : Constable & Co. Price 12s. 6d.

This book is intended as a reference book for analytical chemists. It consists entirely of chemical tables and probably contains more information in a small space and handy form than any similar publication. About half the pages are occupied with tables giving the formula, molecular weight, specific gravity, melting point, boiling point, and solubility, of inorganic and organic substances. Other sections deal with the heat of combustion, specific gravities of solutions, metallic contents of solutions, temperature corrections, expansions, and specific gravity of gases. There are also chapters giving references to recent articles on analysis, and to new books published on the subject. The first issue appeared two years ago and it was intended to issue it every year, but the amount of labour required has made it necessary to alter the original programme.

HANDBOOK OF BRITISH GUIANA, 1909. Edited and compiled by George D. Bayley. Cloth, 8vo. 600 pages. Ill. Georgetown, B. G. : The Argosy Co. London : Dulau & Co. Price 5s.

The editor of this book possesses the rare art of making an official handbook interesting. The series of 50 photographs beautifully illustrating the topography, civilization, and the manners and customs of the aborigines, are in themselves well worth the small price of the book. The editor and contributors are all men connected with the Government and the scientific institutions of the country, and show an intimate and detailed knowledge of their subjects. For instance, the geography and topography is described by C. W. Anderson, forestry officer and government surveyor. The subjects covered by the book are extensive and varied, ranging from the agricultural resources to the fees charged in the courts, from the climate to the cost of living, and from the prices of tools to accommodation for tourists and visitors. The geology and mineral resources are described in short chapters by J. B. Harrison and Frank Fowler. The descriptions are precise but popular, and are suitable for the purpose for which they were written. The same authors have dealt in greater detail with the subject in their book entitled 'The Geology of the Goldfields of British Guiana,' published a year ago.

GEOLOGY OF THE ST. AUSTELL DISTRICT, CORNWALL. By W. A. E. Usher, G. Barrow, D. A. MacAlister, and J. S. Flett. Paper. 202 pages. Ill. London : Edward Stanford. Price 4s. ; and geological map, 1s. 6d.

This is one of the new series of memoirs of the Geological Survey, and it deals with that portion of Cornwall containing the whole of the granitic upland north of St. Austell. This district is the seat of the china clay industry, which, it may be noted, brings in a larger income than tin mining, though, owing to the less cost of winning and to the fact that a larger proportion of the owners reside outside Cornwall, china clay is of less importance than tin as a source of livelihood to the population. This remark is not made in connection with the book now noticed, for its scope and contents are not concerned with commercial matters, but rather with scientific geology, so that the discussion on china clay and china stone is purely mineralogical. This volume also covers the St. Austell tin district and the Goss and Redmoor alluvial deposits.

MODERN COKING PRACTICE. By T. H. Byrom and J. E. Christopher. Cloth, 8vo. 162 pages, Ill. London : Crosby Lockwood & Son. Price 8s. 6d. For sale by *The Mining Magazine*.

Though the iron and coal papers in England, Germany, and America contain many articles on coke manufacture there has always been a scarcity of books dealing with the subject. Fulton's book is a good one, but it deals chiefly with American practice which is behind that of the other two countries; and it has also the disadvantage of being published in such a way as to be difficult to obtain outside America. The present book is therefore welcome. The authors are specialists in coal and coke, being chemist and engineer respectively with the Wigan Coal & Iron Co. in Lancashire, and having in their charge an important installation of Semet-Solvay plant. Not only are they practical men, but they have the additional advantage of a training in the art of presenting and imparting information, for they have both been successful lecturers at the Wigan Technical College. The book is not too scientific or theoretical. It is rather intended for the man who has to build a battery of ovens, make a good coke, and catch every possible by-product. The illustrations and diagrams, which number over 100, are excellent, and add to the value of the book. The space allotted to history and old-fashioned plant is small, for the authors prefer to deal with current up-to-date practice. The construction and working of the Simon-Carves, Semet-Solvay, Hussener, Otto-Hoffmann, Otto-Hilgenstock, Koppers, and Collin ovens are described in detail. Chapters are devoted to charging, discharging and quenching machines, plant for recovering tarry matter and ammonia, methods of utilizing the waste gases for the raising of steam and operating gas engines, etc. There are also chapters containing a study of coals as fuel, the washing of coal, and the analysis of coal and of gas.

PETROLEUM MINING AND OILFIELD DEVELOPMENT.—By A. Beeby Thompson. Cloth, 8vo. 370 pages. Ill. London : Crosby Lockwood & Son. Price 15s. For sale by *The Mining Magazine*.

This volume is a welcome addition to the mining engineer's library, for hitherto there has been no book describing the occurrence and methods of prospecting and developing petroleum deposits. Redwood's book is a classic, but it is of too encyclopædic a character to make it suitable for the use of the mining engineer, and there are also other excellent books describing the manufacture of oil and by-products from shale. Mr. Thompson has also previously given us a book on the Russian oilfields, but this was of too restricted a scope to interest the learner and investigator. We may say confidently therefore that the present publication is just what was wanted.

Until within the last few years the oil industry has not interested the average mining engineer, as the business man, the civil engineer, and the chemist monopolized the work connected with the exploitation of oil deposits. These conditions have changed of late, and many mining engineers and mining companies hitherto identified with the metals are devoting much attention to oilfields in various parts of the world. It is recognized by many that the prospecting and development of oilfields affords some of the most profitable opportunities for the energetic and enterprising mining engineer.

The scope of the work is indicated in the lengthy sub-title : "A guide to the exploration of petroleum lands, and a study of the engineering problems connected with the winning of petroleum ; including statistical data of important oilfields, notes on the origin and distribution of petroleum, and a description of the methods of utilizing oil and gas fuels." The introduction gives a historical and statistical account of the petroleum industry, a description of the various localities where oil is produced, and figures of production. The author then discusses the geological structure and petrological character of oilfields, the indications of the existence of oil, the origin of natural gas and oil, the uses, and the methods of refining. Chapters are devoted to the systems of drilling or boring, to the lining-tubes required in the wells, and to the method of excluding water from the wells. Another chapter discusses the methods for controlling and directing the flow, and raising the oil when it does not issue of its own accord. Further chapters give particulars about the utilization of petroleum for the generation of heat, and the final chapter is devoted to natural gas. The book is beautifully illustrated and excellently printed. It is an admirable text-book by a competent authority on an interesting subject.

Ferro-Silicon, its Nature, Uses and Manufacture.—By S. M. Copeman, S. R. Barnett, and H. W. Hake. Paper covers. 120 pages. Ill. London: Wyman & Sons. Price 1s. 11d.

This is a report presented to the Local Government Board and was prepared with the object of collecting information as to the possible dangers arising from the transport and storage of a new metallurgical product. Ferro-silicon is now made chiefly in the electric furnace in France and Austria, and is imported into this country by steel manufacturers who use it for the purpose of introducing silicon into the charge. The addition of silicon serves several purposes, the chief of which are to impart a hardening effect and to keep the steel fluid during casting, and so make it possible to produce thin and intricate castings. The ferro-silicon usually imported, consisting of a 50% grade, has been found to be dangerous owing to emanations of explosive and poisonous gases. So much so that many deaths have occurred on ships carrying it as a cargo, and at the present time the English importers experience some difficulty in obtaining supplies owing to the disinclination of the shipping companies to accept it as freight. The gases evolved consist of phosphoretted hydrogen and arseniuretted hydrogen. The amount of damage that can be done by these emanations can be gauged from the fact that in an examination of a particular cargo it was found that a ton of the ferro-silicon would disengage 161 litres of phosphoretted hydrogen and 7 litres of arseniuretted hydrogen.

This book gives a most exhaustive report on the uses and methods of manufacture of this substance and of investigations into the poisonous nature of the emanations. It is a valuable monograph.

Sulphuric Acid and Alkali, Vol. II. Third Revised Edition.—By George Lunge. London: Gurney & Jackson. Price 42s.

This volume covers the manufacture of sulphate of soda, hydrochloric acid, and Leblanc soda, and has been revised to date. This series of books by George Lunge is one of the great achievements in the literature of technology. Having been an alkali manufacturer in England before he took up the professorship at Zurich, the author is well fitted for the work of eclectically collecting information on this subject, the basis of all chemical industry. The first volume is devoted to sulphuric acid, and the third revised edition was issued in 1903. The revised edition of the second volume as above mentioned is just out. It is noteworthy as showing the progress in the industry that both the first and second volumes are now issued in two parts. The third volume covers the ammonia-soda, the electrolytic, and other methods. These books are of use to the metallurgist, because they give much information relating to the application of pyrite and the utilization of spent pyrite, sulphurous gases, etc. In addition, their descriptions of all sorts of plant are as useful to the metallurgist as to the alkali chemist.

NEW PUBLICATIONS

Metal Statistics for 1908. 150 pages. Compiled by the Metallgesellschaft, Frankfort on Main.

This is the 15th annual issue of the comparative statistics of lead, copper, spelter, tin, aluminium, nickel, quicksilver, and silver, compiled by the Metallgesellschaft, the Metallurgische Gesellschaft, and the Berg- und Metall Bank of Frankfort. It is distributed in this country by Henry R. Merton & Co., Ltd.

Elements of Metallography.—By Rudolf Ruer, translated by C. H. Mathewson. Cloth. 356 pages. Ill. New York: John Wiley & Sons. Price 12s. 6d.

This book is written by the lecturer at Gottingen and translated by the lecturer at Yale. It covers much the same ground as Goerens' book, which was translated by Ibbotson. Heyn's work has never been translated into English.

Railway Map of South Africa, new edition. London: *South Africa*. Price 1s.

This map is published by *South Africa*, the weekly paper edited by Edward P. Mathers, and it has been brought up to date by the inclusion of the line to the Congo border. It is the most generally useful map of the country published at a popular price. The mineral districts and most of the mines are given, though we miss the Edmundian. While every other detail is revised, why retain the name 'Orange Free State'?

Cement Resources of Virginia. By R. S. Bassler. Charlottesville, Va.: The University of Virginia.

This is one of the publications of the Virginia Geological Survey, and describes the limestones and shales in the Appalachian district of Virginia. This part of the country contains extensive deposits of material suitable for the manufacture of cement.

The Ventilation of Mines. By John Sarvaas. Pamphlet, 60 pages. Ill. Melbourne and London: *Australian Mining Standard*. Price 2s. 6d.

This pamphlet discusses the ventilation of metalliferous mines, and the examples cited are drawn from Australian practice. So many books on this subject are intended for coal mining, and the reasons, other than the removal of firedamp, that render proper ventilation desirable are usually overlooked. The gold miner will therefore find this book applicable to his requirements. The descriptions and the formulas employed are short and to the point.

The Miner's Guide. By F. P. Mennell. Cloth, small 8vo. 190 pages. Ill. London: Gerrard's, Limited. Price 4s.

This book is, in effect, a third edition of the author's Rhodesian Miner's Handbook. Though intended primarily for prospectors and working miners, it can be recommended also to those who are interested in mining in a general way. The author modestly says that the work is mostly a compilation; but for all that he shows an intimate knowledge of his subject.

Hydraulic Mining.—By C. C. Longridge. Cloth, 8vo. 350 pages. Ill. London: *The Mining Journal*. Price 20s.

CURRENT LITERATURE

Assay of Cyanide Solutions.—At the October meeting of the Chemical, Metallurgical and Mining Society of South Africa, L. J. Wilmoth read a paper describing experiments on the assay of the waste acid washes resulting from the clean-up by bisulphate of soda.

Great Falls Smelter.—In *Mines & Minerals* for December, R. L. Herrick gives particulars of the new dust chambers and chimney at the Great Falls smelter, in Montana. The chimney is 506 ft. high with an internal diameter of 50 ft. The Rosing system of catching dust by means of hanging wires has been adopted. This system is described in Hofman's book on 'Lead,' and has not before been used in America. The results obtained by this system at Great Falls have not been published.

Planillas.—In the *Western Chemist & Metallurgist* for November, H. J. Baron gives reminiscences of the old metallurgical methods used by the natives of Mexico; in particular describing the *planillas*, a concave buddle. This concentrator resembles that used in the tin mines of Yunnan and described by W. F. Collins in another part of this magazine.

Coalfields of Chile.—A paper on the coalfields and collieries of Chile was read at the last meeting of the Mining Institute of Scotland by Archibald Russell. The paper gives details relating to the history, geology, and economics of the coal production. The coal is used by the railways and smelters, but its quality is indifferent; and since South Wales and Australian coals can be shipped cheaply as return cargoes in the nitrate fleet, the foreign coal is a strong competitor.

Detecting Traces of Gold in Rock.—A. R. Andrew, in a paper read before the January meeting of the Institution of Mining and Metallurgy, describes investigations into the accuracy of the methods used in detecting minute traces of gold in country rock. His results so far have been negative, for he has not found a method of entirely freeing litharge or any lead salt used in the assay from traces of gold and silver, the presence of which will vitiate a close analysis.

Measurement of Vacuum-filter Capacity.—In the November issue of the *Monthly Journal* of the Chamber of Mines of Western Australia, Thomas B. Stevens presents rules and tables for calculating the fluid and solid contents of slime and filter cake.

Titaniferous Iron Ore.—G. H. Stanley read a paper on the smelting of titaniferous iron ore at the November meeting of the Chemical, Metallurgical, and Mining Society of South Africa. He reviewed the attempts in England and the United States to smelt these ores, and gave the results of his researches on the slags obtained from Transvaal ores.

Assay of Gold Alloys—Ernest A. Smith, of the Sheffield assay office, contributed a paper on the analysis of industrial gold alloys to the January meeting of the Institute of Metals. The author describes the methods adopted for assaying the various recognized qualities of gold used in the arts and manufactures, and gives information hitherto unpublished.

Sweetland's Filter Press.—E. J. Sweetland describes his filter press for treating slime in the January issue of *Metallurgical and Chemical Engineering*. This filter is somewhat similar in construction to those of the Butters and Moore type, but the solution is pumped through the leaves at a pressure of 60 lb. instead of being drawn through by vacuum. By this high pressure the cake is said to be formed more quickly. Mr. Sweetland also contributed a paper to the *Mining and Scientific Press* for December 25, discussing the principles involved in the relative efficiencies of pressure and vacuum filters.

Electrostatic Zinc Separation.—In *Mines and Minerals* for January, Leroy A. Palmer describes in detail the Huff and the Blake-Morscher machines for removing blende from complex sulphides.

Malm Dry Chlorination Process.—R. L. Herrick, in *Mines and Minerals* for January, writes of the dry chlorination process now being developed by John L. Malm at Georgetown, Colorado. The plant is under construction and should be at work in May. The process is a modified form of the Swinburne-Ashcroft process, the chief improvements consisting of improved cells for generating chlorine, and apparatus that will withstand the corrosive action of the gas.

Copper-Arsenic Alloys.—At the January meeting of the Institute of Metals, G. D. Bengough and B. P. Hill read a paper on copper-arsenic alloys. The paper dealt with copper and brass to which small proportions of arsenic have been added to improve the strength and rigidity, and to help them to resist the action of flames, such being used for the construction of fire-box tubes. The authors discuss the best proportion of arsenic, and the effect of heat-treatment and of heating in a reducing atmosphere.

Hopkins Zinc Process.—At the January meeting of the Institute of Metals, C. O. Bannister read a paper on the Hopkins zinc process. The invention consists of a carbonaceous filter fitted in the condenser, with the object of producing a zinc free from lead and of preventing the escape of zinc fume and zinc oxide. The device has been tried at Swansea for some time and success is reported; but further results will be appreciated.

The Geology of Tonopah.—In *Economic Geology* for December, J. A. Burgess presents a paper describing the geology of the Tonopah mining district. The author differs in opinion from J. E. Spurr, arguing that the district is composed of a series of successive lava flows and tuffs.

Mine Accounts.—In the *South African Mining Journal* for December 31, G. W. Tait commences a series of articles relating to the methods adopted for keeping accounts and estimating costs at the gold mines on the Rand.

Mine Timbering.—In the December issue of the *Bulletin* of the Canadian Mining Institute, D. J. Browne, of Rossland, B. C., describes a method of setting-out the timbers for inclined shafts.

Alloys Research.—At the January meeting of the Institution of Mechanical Engineers there was presented the ninth report of the Alloys Research Committee. This report is entitled: "On the properties of some alloys of copper, aluminium, and manganese with an appendix on the corrosion of alloys of copper and aluminium when exposed to the sea." The authors are W. Rosenhain and F. C. A. H. Lantsberry. The first report of this committee appeared in 1891.

Mine and Mill Practice on the Rand.—With the issue of the *Engineering & Mining Journal* for January 15, E. M. Weston, of Johannesburg, commences a series of articles relating to the modern principles of consolidating mining interests on the Rand and of erecting machinery on a large scale for the purpose of economically working the large tracts of low-grade ores.

Cyanide Practice.—The *Mining and Scientific Press* for January 1 contains Alfred James' annual cyanide letter.

Lake Superior Copper.—R. H. Maurer, in the *Mining and Scientific Press* for January 1, gives a review of Lake Superior copper mining during 1909.

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Scientia non habet inimicum nisi ignorantem.

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CONTENTS.

REVIEW OF MINING

THE STOCK-MARKETS have not been affected by the political *impasse*, despite the disarrangement of the national finances. Owing to the non-collection of income tax the supply of money is plentiful and the Bank rate stands at 3%. Fine weather has discounted political pessimism and spirits damped by continuous rain have responded to days of sunshine.

RUBBER.—The speculative interest of the moment is directed to rubber, the share market shows a resilient mood, and the man in the street has erased his past memories of excitable finance. Rubber and oil have almost shouldered mining off the pavement of Throgmorton Street, the daily Press has been loaded with the prospectuses of new rubber issues, and the directors of 'wild cats' are asking whether the surface of their abandoned claims may not be well adapted to the cultivation of the popular product. Rubber takes the place on the gambling table given formerly, and successively, to coffee, cocoa, cinchona, and nutmeg. All of these had their 'boom,' all of these were cultivated on a large scale under artificial conditions in new regions, and each in turn suffered from borers, caterpillars, or other destructive parasites. In the case of rubber it appears to be the white ant or a fungus that attacks the roots of the plant. Nature is not easily controlled nor readily understood, a plant that is grown in a country to which it is not indigenous may do well at first but may succumb later to enemies unknown before. Of course, this may not become apparent until fortunes have been made and lost on the exchanges, but it is worth while to point out that over-production and share inflation are not the only dangers threatening the rubber business.

TRANSVAAL.—On February 28 the last Chinese coolie was repatriated from the Rand and an interesting chapter in the history of South Africa was definitely closed. The incident has tended to revamp some of the misdirected sentiment that was injected into British politics four years ago, but it has provoked no comment of importance. The labour problem, solved temporarily by the importation of the Chinaman, still faces the statesmen of South Africa, and it will test their sagacity in the near future.

Analysing the progress achieved in 1909, Mr. J. W. S. Langermann, the president of the Chamber of Mines in the Transvaal, was able to point to several satisfactory features. On the Rand the production of gold increased 258,598 ounces worth £1,008,996. Of the yield 60% was absorbed in the cost of production, 31% in dividends, and 9% in taxes, interest, and capital expenditure. Dividends were 2% better than in 1908. The Transvaal produced £30,925,788, equivalent to 34% of the world's total gold production. The confidence of investors appeared to be fully restored, as capital for development is raised easily. In regard to labour, Mr. Langermann laid stress on the increase of white workmen, who number 23,077, an increase of 18%. Of native labourers 183,256 are employed, or 4152 more than in the year previous. It is true that despite an increase of coloured labour, the supply in 1909 was so inadequate as to retard operations at many productive mines and to check new schemes of development. During the last month of 1909, however, the tension was much relieved, and he was of the opinion that there was no occasion for serious misgivings. The Union of South Africa was a fact full of promise; it was "the outward expression of a genuine union of peoples, a sincere desire to obliterate racial questions, and a firm determination to build up a strong nation."

Attention has been directed to the East Rand by Mr. W. W. Mein's report on the New Modderfontein and by the increase of capital—£522,000—required to erect a large mill, as well as to complete the equipment and development of this mine. The capacity of the plant is to be 91,500 tons per month, which compares with the 70,000 tons crushed monthly by the Simmer & Jack, and the 160,000 tons to be treated by the 600 stamps of the new Randfontein Central mill.

RHODESIA.—The meeting of the Chartered company must have gratified the shareholders, who, at last, seem to be in sight of some tangible return for their investment. We hope they will be rewarded, for among the larger commercial enterprises of an empire-building people, the British South Africa Company takes an honoured place.

And there is a good warrant for cheerfulness, for the agricultural settlement in Rhodesia, the activity of prospectors, and the better news from the deeper mines all point to an accelerated development of the British South Africa Co.'s domain. But an inflated share-market is an immediate source of danger, of which there is copious evidence. Already the improvements at the chief mines have been translated into price-increments that presage heavy losses for the simple and greedy. Company-mongering easily out-distances the slow work of actual mining, and unless the pace is retarded we shall have a disastrous reaction.

It is interesting to note that all the large South African financial firms have acquired mining property in Rhodesia; of these the largest holdings belong to the Consolidated Gold Fields; others are Farrar Brothers, Neumann & Co., A. Goerz & Co., Lewis & Marks, and General Mining & Finance (Albu brothers), the last mentioned having bought a 75% interest in the Beatrice mine. Among recent issues is the Rhodesian Abercorn Shamva Trust, a company as complex as its name, for it represents scattered holdings in Rhodesia, but chiefly in the Abercorn district, where it has a 30% interest in the Shamva claims, which are controlled by the Consolidated Gold Fields. This Trust is therefore intended not for administrative purposes, but to facilitate share-dealing.

At the meeting of the South African Gold Trust, the chairman, Lord Harris, warned shareholders that they must exercise patience in West African affairs owing to the unhealthiness of the tropical climate, which was such as to preclude the energy shown on the Rand and in other stimulating high regions. He acknowledged that labour scarcity is always a cause of anxiety in South Africa, but he also emphasized the value of the Government's assurances that there is a sufficiency of labour in the country if only properly recruited.

WEST AFRICA.—During the month the Ashanti Goldfields has attracted attention by the issue of the prospectus of the exploring company called Ashanti Goldfields Territories. The object of this new company is to take in hand the exploration of a tract of country hitherto undeveloped. The Goldfields company has the rights over 118 square miles, and, so far, operations have been confined to the 7 square miles already proved to be productive. The Territories company will undertake this work under the guidance of Mr. W. R. Feldtmann, the consulting engineer, and Mr. J. N. Justice will be the manager. The new company is an exploring and prospecting enterprise with a capital of £300,000, in shares of 5 shillings each. Of this amount the parent company receives 400,000 shares, while 401,800 is issued now in order to provide working capital. The Ashanti Goldfields is also able to report well on the developments at their Obuasi working. From No. 3 to No 7 level, a vertical distance of 330 ft., the whole of the development is in profitable ground, some of it being in ore averaging 2 oz. per ton over a width of several feet. The latest report is that at the 7th level the average is 19 dwt. over 8 ft. Another important event of the month in connection with West Africa is the issue of fresh capital by Prestea Block A for the purpose of providing money for the new equipment and for additional development. Approximately £180,000 is to be spent, half for development and half for new plant. The company has £72,000 cash in hand and further funds are being raised by the issue of 100,000 more shares at 27s. 6d. The new issue has been guaranteed by the firms interested in the company.

Australia.—The back of the coal strike is broken and we hope to hear that general industrial recovery has ensued. The extension of the tailing-treatment at Broken Hill continues. Amalgamated Zinc (De Bavay's) has just completed the first unit of the new plant. This will treat 12,000 tons per month of tailing from the Broken Hill South. A second unit for the treatment of tailings from Block 10 and North Broken Hill is to be erected, with a capacity of 18,000 tons per month. The old plant still continues to treat 8000 tons per month of mixed tailings from North Broken Hill and Broken Hill South. With regard to the North Broken Hill Co., 35,000 shares are now offered to shareholders at £2 each, with the object of paying for the new mill, the cost of which has hitherto been defrayed out of revenue. This mine shows extraordinary prosperity and will within a few weeks be treating 6000 tons of ore per week at a total working cost of 13s. 10d. per ton. The ore reserve is sufficient to last for 5 years and developments continue to expose further supplies.

The amalgamation of the Lake View and Hannan's Star companies was anticipated, but it is not a merger in the full sense as both companies retain their existence, but a new corporation will be formed with £209,000, and in this the old companies will each have a half interest. The depletion of the famous Lake View mine has caused the diversion of the company's capital to other enterprises at Broken Hill and in Burma. On the other hand the Lake View mill will prove valuable to the Hannan's Star, and will permit of an economical treatment of the combined output of the two mines, which contain 600,000 tons of available ore.

Indian Mines.—An excellent impression has been given by the publication of results for 1909 by the Mysore and the Nundydroog mines. The dividends have been announced at 115% and 40%, respectively, and in addition each company has been able to put aside £20,000 to form the nucleus of a reserve fund. The creation of such a fund is a continuation of the policy adopted three years ago when the old system of meeting special or extra expenditure by the creation of new capital was abandoned for the current system of paying for everything out of revenue. The Mysore mine is in good condition and has an ore reserve of one million tons. Another item of news in connection with Indian gold mines relates to the Dharwar Reefs ; for some time the exploratory work disclosed nothing but barren ground, and as both the ore reserve and the capital were practically exhausted, the outlook was decidedly discouraging. Just recently the work at the 1040 ft. and 1140 ft. levels has given better results and the superintendent, James Roberts, has recommended a continuation of operations. Capital is to be obtained by forming another company, the Kabulgitti Gold Mines, offering preference shares to the present shareholders. It is also reported that success has at last attended the labours of the metallurgists in connection with the treatment of the graphitic tailing, so that from both points of view the outlook for Dharwar Reefs is more hopeful.

United States.—On March 3 came the news of a fatal explosion at the Alaska Tread well mine, on Douglas island. Later despatches indicate that an explosion of dynamite on the 1100-ft. level of the Mexican min-killed 29 men and injured 11. The Alaska Mexican is one of the three adjoining mines under the same management; it is stated that the other two, the Alaska Treadwell and the Alaska United were not affected by the explosion.

Another serious fatality is reported from the Cœur d'Alene region, in the State of Idaho. On February 28 an avalanche or snowslide overwhelmed the little mining settlement of Mace, where are situated the Standard and Mammoth mines of the Federal Mining & Smelting Co. Fully 100 persons were killed, among them being J. H. Pascoe, the superintendent of the Standard, a Cornish mine-captain well and honourably known in that part of the world. We publish photographs of the Standard mine and also of Burke, a neighbouring mining town, which also suffered from a snowslide on March 1. In this case the loss of life was small, as the inhabitants had been warned to leave their dwellings. Subsequently huge snowslides overthrew trains on the Northern Pacific and the Canadian Pacific railways, causing great loss of life. It will be remembered that on March 17, 1906, a snowslide fell upon the Camp Bird mill, the remains of which were then consumed by a fire that started in the ruins. Snowslides are common in the Rocky Mountain region early in spring; they are due to accumulation of snow on deforested slopes and exact a heavy annual death-rate among those engaged in mining at high altitudes.

During February the labour trouble at the Homestake mine was largely overcome by the employment of non-union miners, so that 640 out of the 1000 stamps resumed crushing. The other mining companies in the Black Hills have decided to discriminate against the Union and to employ only non-union labour.

CANADA.—Our Toronto correspondent refers again to the rush of prospectors and speculators to the new goldfield near Porcupine lake in Northern Ontario. The scene of this latest mining excitement is just north of the 'height of land' or 'divide' separating the watersheds of Hudson's Bay and the Ottawa river. Porcupine lake may also be described as between the Mettagami and the Abitibi rivers. Hence it can be reached in summer by canoes and is well provided with sources of water-power. At present the camp is reached by winter roads from two points on the Temiskaming & Northern Ontario railway, the distances from the railway being 35 and 40 miles, respectively. The topography favours the extension of the railroad to the mines, as the country is flat and only one large stream will have to be bridged. Good farming land is contiguous to the low ridges on which gold-bearing quartz veins have been found. These veins are large—from 5 to 25 feet wide—and persistent in their strike. It remains to be proved whether the valuable ore persists in depth below the zone of superficial enrichment. The experience of the Lake of the Woods should warn the unduly sanguine, while the story of Cobalt may well encourage the energetic.

THE ORIENT.—A diplomatic imbroglio is in a fair way of adjustment in Manchuria, the proposal of the United States to internationalize the railway system having been rejected both by Russia and Japan. This is not unexpected, although we may appreciate the excellent intentions of the American government, namely, to eliminate a fruitful source of international misunderstandings and to create a real 'open door' into a most important Chinese province. Between the Russian railway in northern Manchuria and the Japanese railway in southern Manchuria, the domination of China is being ground to powder. The 'open door' is an idle phrase when the front door into the country is jealously guarded by the soldiers of Russia and the back door is blocked by the soldiers of Japan. Apparently the Japanese are unwilling to surrender the fruit of their desperate war and intend to destroy the last shadow of Chinese sovereignty in Manchuria. England may be bound by treaty to support Japanese ambitions in China, but the United States is free to protect her citizens, whose interests in this case are identified with those of many other countries. We published two articles recently on the mineral resources of Manchuria. The coal and iron may have to await the further industrial development of the country, but the exploitation of the gold deposits need not depend upon a local market. In a recent issue of the *National Review*, we are told that gold is known to exist all the way from the Liaotung peninsula to the Amur. The upper valley of the Amur is said to contain gold-bearing conglomerate, or 'banket.' In the beds of the tributaries of the Tumen, the precious metal has been detected ; between Blagoveschensk and the Sungari river the settlements of Tai-ping-kou are dependent upon gold mining; between the Shilka and Angun is Mo-ho, another important mining community. Most of the mines are operated under Government superintendence and are protected by troops against bands of marauders.

It is announced that an Anglo-French company will exploit the gravel deposits of Aporoma, in Peru, from which the Incas are supposed to have derived their gold. An expedition has recently returned from this district, bringing a favourable report.

SILVER.—The imposition by the Government, of an increased duty on the silver imported into India, came as a surprise when it was made known in the Indian budget. The effect of the increase from 5% to 15½% (4 pence per ounce) ad valorem is not yet understood ; at first the quotation for the metal dropped a half-penny, recovering slightly later. This new impost has nothing to do with the currency or money problem and has been made solely for the purpose of raising additional revenue. Now that the export of opium from India to China is being curtailed, the public revenue from this source has been greatly reduced ; hence the necessity for other taxes. The new tax cannot be said to be oppressive, for the price of silver in India will still be far below the average of recent years. As the present price of silver in the world's markets promises to remain at a low level for an indefinite period, the Indian Government evidently saw the opportunity of raising revenue by taking advantage of a permanent fall in the price of one of the chief commodities bought by the community.

COPPER.—The Nevada-Utah consolidation has fallen through, by reason of the energetic opposition led by Mr. James Phillips and his friends. Independent shareholders in Europe have expressed strong dislike to the merging of Nevada Consolidated with Utah Copper and decided objection to the tactics pursued by the Guggenheim group. Certainly the methods adopted to value the two big mines are not such as to command respect ; the opinions of interested parties and the estimates of non-technical persons have been prominent while the actual appraisals of competent and unprejudiced engineers have been inconspicuous. But, although the original scheme of consolidation may be abandoned, we shall be surprised if the purpose is not effected indirectly, by means illustrated in the Anaconda-Amalgamated episode. The Guggenheim group have secured enough Nevada shares to be able to control the market for those shares, and by keeping the latter at a low figure, and the Utah at a relatively higher price, it can be made advantageous for the Nevada shareholders to come into the consolidation. Meanwhile, the idea of a widespread merger of copper-mining companies has been amply discounted in every way possible, and is no longer effective to boost shares. The high quotations reached during the recent boom have anticipated all the advantages expected to accrue.

The American Copper Producers' Association states that stocks of metal in America were 43,957 tons on February 28, as against 63,285 in January ; production 50,318, against 52,030 ; exports 16,684 against 36,469 tons.

THE STANDARD AND MAMMOTH MINES IN IDAHO.
The scene of the avalanche.

THE TOWN OF BURKE, IN IDAHO,
Recently endangered by snowslides.

EDITORIAL

ARRANGEMENTS are nearly completed to start the Mining and Metallurgical Club. Invitations to join the club when established were accepted by about 600 men and the provisional committee has found suitable premises, in a central locality and otherwise well suited to the purpose of the Mining and Metallurgical Club. At a recent meeting of the Club committee, Mr. Sidney H. Farrar was chosen as president. As soon as the necessary contracts have been signed, members will be duly informed concerning details; they will then be invited to qualify by paying the subscription, and a general meeting will be called at which a full statement will be offered by the President. It is hoped that the Club may be established early in May.

NO better illustration could be afforded of the muddle created by merging the duties of the engineer with those of the promoter than the vagaries of the Nevada-Utah amalgamation. When the legal and engineering advisors of mining companies take a hand in the unlimited game of finance, it is not surprising that the shareholders should be at a loss to know to whom to turn for advice. When engineers express opinions like brokers, and in the interest of brokers; when lawyers give advice in the interest, not of their clients, but of their financial associates; when directors play a lone hand, oblivious of their responsibilities as trustees, then the business of mining assumes an aspect that makes faro look respectable and gives to poker the status of a Sunday-school pastime.

SATISFACTORY technical terms are not always available. Such words should fully express the ideas or the things for which they stand, and they should be intelligible wherever the language is spoken. Local terms will not suffice and vulgarisms should be rejected, because both fail to perform the duties designated. These remarks are made as a preliminary to asking our readers to suggest a satisfactory English word to express the ore fed to the machinery of a stamp-mill or a concentrator. 'Mill-stuff' is an old British term, which we do not like. 'Mill-feed' is an American vulgarism, which should be taboo. 'Mill-ore' is available, but it is not fully expressive, as not affording sufficient distinction from the general product of the mine, some of which is shipped to the smelter. We need a term to cover the ore prepared for, and supplied to, the mill. Suggestions will be welcome.

WE NOTE with pleasure that the technical men acting for the San Francisco del Oro Mining Company have been successful in finding a means for treating a difficult ore. Scarcity of water was the original worry, but a supply was found a year ago. Another trouble has been the presence of fluorspar, which rendered the zinc concentrate unmarketable, the fluoric acid corroding the retorts in which the zinc is distilled. An attempt was made in Wales to apply the flotation process, but the high consumption of acid due to the presence of calcite in the ore was a decisively unfavourable factor; however, the smelting of the concentrate was sufficiently successful to place the company in a strong position as regards the zinc smelters, and thus facilitated an arrangement with the latter whereby they agree to purchase the roasted zinc middling on terms profitable to the San Francisco del Oro company, besides opening an even more favourable market for the zinc concentrate. In the meantime the system of treatment to be adopted at the mine will involve the production, by wet concentration of a lead product, to be sold locally, and also of a roasted zinc product, to be shipped for sale in Europe. Thus a complex zinc-lead ore is rendered profitable. Even if the metallurgical solution may have no remarkable scientific features, it performs the chief function of metallurgy, namely, to beneficiate ore profitably, thus fulfilling the purpose of mining, which is to make money out of ore.

IT IS NOT yet known what is to be the effect of the expulsion of the Dalai Lama from Lhasa and his flight to British India. The Chinese have broken down the barriers that enclosed 'the roof of the world' and have taken practical steps to assert their suzerainty over the land heretofore ruled by the Buddhist hierarchy at Lhasa. Thus another corner of the world will be thrown open to mineral exploration, if not to industrial development. The Chinaman may not be the exponent of the 'open door,' but his ideas of international hospitality are at least in advance of that of the monks of the Potala. At this juncture we note with interest that Mr. Alexander Del Mar has a scholarly article on the gold mines of Tibet in the *Mining and Scientific Press*. He infers that the mines to which Herodotus, Ctesias, and Megasthenes allude, were in Tibet, although it must be noted that at the time of these historians Tibet reached to the Polar sea, and thus included a large portion of Siberia. Alexander the Great made inquiries, and his historian, Strabo, recounts the story of valuable mines of gold and silver in the far off mountains of the Grand Lama. The gold has ever been "sacred to the Grand Lama" and for this reason, as much as religious sanctity, the country has been closed to the rest of the world. Successive British explorers have returned with accounts of gold placers, some of which, of course, must be exhausted ere this. The search for gold has been in progress from a remote antiquity and it is in accord with experience elsewhere that it should be revived again under more favourable conditions.

THE death of Arthur F. Walter, of *The Times*, removes a link with a past from which every journalist draws inspiration. Born in 1846 and the son of the third in succession of the John Walters whose names are synonymous with the highest development of British journalism, he represented the family that for 120 years has guided the policy of the greatest newspaper in our language, or in any language. His connection with *The Times* dated from the spacious days of the great Delane, an editor who ranked in his influence with Prime Ministers and Secretaries of State. During his life he saw the influence of his paper shaken by the Parnell letter fiasco, discredited by the Encylopedia enterprise, ridiculed by the Book Club scheme, and finally yellowed by the irruption of the Harmsworth regime, until on the day of his death he must have known that *The Times* of John Walter and John Thaddeus Delane was becoming almost as undignified as the half-penny excitable Press and almost as commercialized as the American purveyors of misinformation. With A. F. Walter we lose a link with a glorious past and by his decease we are reminded of the decadence of a national asset of which every Englishman was once proud.

YOUNG ENGINEERS are prone to essay feats of a grandiose character, such as diverting the water of one stream and conveying it, by ditch or flume, across a dividing range into another stream. They love to plan aerial tramways that make the rough places of the earth seem smooth and to overcome natural obstacles like intellectual chamois. To them steep hillsides afford good sites for a mill, in disdainful disregard of the cost of the necessary retaining walls. There is exhibited a fine eye for the possibilities of engineering and too little heed for the profit that is the aim of practical mining. Flumes, ditches, tramways, and mills are not the object of mining, they are but the accessories, sometimes unnecessary; the purpose of mining is to make money, by the application of technical skill and organized common sense.

ELSEWHERE we refer to the diplomatic fencing over the Mongolian railway system. Apparently Russia desires to divert attention from the rich country tributary to Blagoveschensk. Hence the counter-proposal to build a railway from Kalgan to Kiachta. In our November issue we referred to mining in the Far East and mentioned the Anhui concession, over which Sir John Lister Kaye and his associates were in controversy with the Chinese Government. The London and China Syndicate, representing the British concessionaries, claimed that they had proved the existence of iron ore to the value of £836,000, while the Government, being anxious to cancel the concession, offered £50,000 in compensation. The matter was taken up by the British Foreign office and it is now stated that the Chinese Government is willing to close the episode by paying £52,000 to the Syndicate.

Professional Ethics.

Under 'Discussion' we publish a letter from Mr. Horace G. Nichols, who expresses his frank dislike of latitudinarian sentiment on a matter vital to the best interests of the profession. In the preceding issue of this Magazine we published the views of other leaders of the profession, notably Messrs. E. T. McCarthy, Frank Merricks, and Alexander Hill. We have, of course, received numerous letters not intended for publication, enough to make it clear that the more thoughtful engineers are agreed in the unwisdom of advising young students to start their careers with the plain purpose of participating in the profits and perils of promotion. We like particularly the plain statement of Mr. Hill that if he imagined "for one moment that such ideas were countenanced at the Royal School of Mines," he would be unwilling to allow his son to remain there as a student. We are glad to know that such an address as was delivered before the Colorado School of Mines would be most unlikely to be heard at South Kensington; and if it were, the expression of protest would be unmistakable. The School associated with the names of Percy and Smyth, Huxley and Judd, is not deficient in traditions nor lukewarm in the support of professional ideals. Another engineer, distinguished in metallurgy, informed us that he had sent his son to the United States to obtain a practical apprenticeship at smelters, and in sending him thither he had urged the young man not to neglect "the higher economics," meaning thereby that he must study the financial arrangements involved in the management of reduction works, the purchase of property, the origination of enterprise, and so forth. It appeared that the father wanted his son to become well informed in these matters, not with a view to participating, but simply to place him on his guard and to equip him with a necessary knowledge of the ways of the world. To learn higher mathematics, it is not necessary to go to Monte Carlo. Surely we have long ago discarded the idea that in order to know how a thing is done, we must do it ourselves. That is a relic from the days when rule-of-thumb was the only teacher. A judge need not be a criminal in order to possess a clarified judgment in criminal affairs, a doctor does not need to buy and sell drugs in order to prepare an accurate prescription, and a mine superintendent may know whether a man is breaking ground properly without ever having handled a pick himself. One of the first attributes of a properly trained technical man is his ability to make observations carefully and to come to conclusions accurately. We do not need to speculate in shares to appreciate the fact that mining is a business the purpose of which is to make money ; we do not need to dabble in promotion in order to obtain a just appreciation of the ways of finance, nor do we need to be rich in order to be engineers. If, on the other hand, mining engineers are to aim to become financiers, if the students are to be told " to go after the stuff"—an American vulgarism that expresses the new ideal of the ex-President of the American Institute of Mining Engineers —if the one object of engineering is to make money, if mining engineering is to be trade, not a profession, then let us put an end to the pretence of professional ideals, let our professional societies disband, let our professional journals cease from publishing, and let us devote ourselves without reserve to the pursuit of the elusive shekel. Not yet ; not for a long time yet. The ideals remain, the profession survives, and the young men now at the threshold of their careers will perpetuate an honourable tradition and put into practical effect a teaching that deems it not impracticable to apply science to industry without participation in the betting of the stock exchange and to promote the business of mining without becoming a partner in the pawnshop.

Brokers and Jobbers.

Dissatisfaction has been freely expressed over the new rules of the Stock Exchange and the subject has gained prominence by reason of the plaintive protests made by friends of the jobbers, whose customary profits have been diminished. To those unacquainted with the customs of the Stock Exchange it may be explained that the middlemen who facilitate the buying and selling of shares include the broker, the outside broker, and the jobber. The first is a member of the Stock Exchange, the second is not and has to deal through the first, while the third is a scout or feeder of business to the brokers. Usually two of these levy a small tax on each transaction : thus if a share be quoted at $4\frac{1}{8}$–$4\frac{1}{4}$, the difference of one eighth of a pound, or 2s. 6d., represents the jobber's 'turn,' in addition to which there are two brokerages, each of 6d. per share, paid by the buyer and seller, respectively ; thus the middlemen get 3s. 6d. altogether. If, however, the purchaser goes direct to an outside broker he saves one commission, as well as the jobber's 'turn,' the saving being shared by the purchaser with the seller, so that each escapes being taxed 1s. 6d. The part of the outside broker may be assumed by the financial house controlling the bulk of the shares in the particular mine ; in that case the 'house' tacitly agrees to distribute the commission just as the outside broker does. The results of these practises has been to drive business away from the Stock Exchange and to the 'big houses' or corporations issuing and promoting mining undertakings. The public has been quick to take advantage of the situation because the average man does not see why a fee should be paid to both broker and jobber. The net result of the new rules of the Stock Exchange is to prevent this very tendency and to stop such dealings by compelling the jobber's 'turn' to be included in the broker's commission. To avoid being mulcted, the public goes to the 'houses.' Moreover, the agents of brokers in the provinces and on the continent, as distinguished from members of the London Stock Exchange, now make it a practice to apply, by interview or letter, to those known or supposed to have large share-holdings in various mining companies, and to them they make the offer to trade on the middle price, eliminating the jobber's turn. A big business of this kind is being created. This does not apply to bonds or gilt-edged securities, but to mining shares.

The theory underlying the institution of the jobber is that he maintains a reservoir of shares so that the customer of the Stock Exchange may be able promptly to buy or sell ; in practice, however, the jobber has long ceased to carry such supposed reserve, deeming it better business to balance his books every night, as far as possible, so that any large block of shares is rarely digested promptly. As long as the jobber carried a reserve of shares he acted as a brake upon the rapidity with which quotations might rise or fall, but now he lags superfluous on the financial stage. Formerly the big houses notified the jobber whether they were buying or selling, using him as a mere agent or they might even "go half-book with" him, but now all this has been stopped in the interest of the broker, not the public, which derives no benefit from the new regulations. Nowadays the house is the real reservoir for shares and is in a position easily to inflate or depress prices. If the orders coming to the house signify that the public is nibbling or if news from the mine is good, the house can direct the movements of the market, apart from the question of immediate supply and demand. The general tendency therefore is to eliminate an unnecessary middleman and to accentuate the influence of the big financial corporations devoted to mining enterprise.

Camborne School of Mines.

Of all the unpretentious efforts to train young men for a mining career we know of none that has so well earned general respect as this modest institution in the heart of the 'old county,' as it is affectionately termed by Cornishmen the world over. Our readers are aware that some good work has also been done by the small mining schools at Redruth and Penzance, but the scattering of energy has been prejudicial to instruction in metalliferous mining, so that the Cornwall County Council was finally impressed with the necessity for consolidation. Last year a special committee was appointed and it was on the advice of this committee that plans were formulated for one comprehensive institution under the name of the School of Metalliferous Mining (Cornwall). The Board of Education approved the scheme and issued the necessary papers in October 1909. It is hoped to associate the Cornish school with the metropolitan institution that now includes the Royal School of Mines and is known as the Imperial College of Science and Technology. Further, it has been arranged that the leading engineering associations, such as the Institution of Civil Engineers and the Institution of Mining and Metallurgy, should appoint representatives on the governing body of the Cornish consolidated school. Thus a thoroughly representative body of men is placed in control. The predominant partner is the Camborne School of Mines, to the success of which Mr. J. J. Beringer has so largely contributed, both by his ability as a teacher and by his character as a man. We understand that for reasons of health he would be glad to lighten his labours, but, with a singleness of purpose and an unselfish enlightenment fully in keeping with his entire career, he is willing to start the new work and to aid whomever the Governors may appoint to the post of Principal. Applications for this position have been invited and among the applicants are several who by training and character seem well fitted to assume the responsibilities of chief executive in the administration of the school. We await with interest the announcement of the appointment and shall deem it our privilege to support those who are trying to give Cornwall a mining college worthy of the reputation long enjoyed by Cornishmen as the teachers of practical mining in every quarter of the globe.

Esmeralda Consolidated.

Among the prospectuses appearing during the past month we note one that invites legitimate criticism because it exhibits so many of the features that tend to discredit the business of mining. This company is formed to operate a group of *antiguas* or old mines in Mexico concerning which a number of vague statements are made, such as are related about most abandoned mines in Spanish America.

The vendors are the promoters and they sell for £100,000 a property that, according to the contracts disclosed, they purchased for a small sum in cash and in shares. No work seems to have been done nor are there any developments related such as would explain the enhanced price. It is expressly stated that the statements in the prospectus are based upon the faith of a report by Mr. J. J. Nicholl, M.I.M.E., F.G.S. We note also that Mr. Nicholl "is prepared to act as mine manager if so appointed by the directors." Not knowing anything of Mr. Nicholl's qualifications for such work—for M.I.M.E., and F.G.S. are not the marks of an experienced mine manager—we are not prepared to criticize the appointment on personal grounds, but we do demur to the practice of placing in charge of a mine the man on whose advice it was purchased. This blunder has been made often; in the first place, the expectation of the appointment is apt to vitiate the appraisal of the mine, for it is obvious that an unfavourable estimate precludes the possibility of appointment to the post, while, should a too optimistic judgment be formed, the real condition of affairs is not made known until too late, as all the information sent from the mine is transmitted through a prejudiced channel. It is always advisable to exercise the utmost care in getting a thoroughly unbiased opinion concerning a mine about to be purchased, and to that end it is well to postpone the selection of a manager until such action is no longer prejudicial to an unbiased appraisal. The report on the Esmeralda contains too much geology and too little sampling. A few samples properly taken are worth an equal number of paragraphs concerning the general geology of a district. Nor can we accept the geological data furnished, despite the F.G.S.; we are told that limestone and gneiss alternate, constituting a formation of Laurentian age. This is not convincing. The writer of the report after confirming "the nature" of the mineral outcrops is enabled to say that he has "not the slightest doubt that they overlie bodies of ore of extraordinary richness." If he were less of an F.G.S. and more of a miner he would, we think, be less confident. The Esmeralda lode is a "fissure vein" in magnesian limestone and contains gold "associated with iron and manganese oxides"—this last a mineralogical touch of no significance. Some of the samples "went as high as 15 dwt. per ton in gold," but it is not related how many samples were taken or how low the poorest assayed. "Average assay values" are quoted elsewhere in the report; the writer apparently fails to recognize that such results have no practical meaning unless the width of ore sampled is given, together with a statement of the range of the results. Another lode "carries sulphides of silver and zinc in matrix of carbonate and calc-spar"—a sentence that may impress an untechnical director, although it is nonsense to one who understands the meaning of the words used. But the most daringly sanguine statement is that referring to the dumps, which are said to contain 330,000 tons of ore, assaying "20 ounces of silver and 10 per cent of lead." We need not tell those who have had experience in Mexico what Dead Sea apples the old dumps often proved—for example, at Guanajuato. In the prospectus it is stated that "these great accumulations are the result of workings begun at a date so far back as 1700, and it may be reckoned that the larger part of the ore extracted was left on the dump-heaps and not treated, as only picked ore of great value was utilized, because of the heavy cost of transport, etc." This is an old fallacy, which has done duty many a time in prospectuses offering shares in Mexican *antiguas*. Only when these potentialities of wealth have been purchased and exploited have the new owners learned at their expense that most of the old dumps have been carefully culled again and again by the *buscones* or Mexican tributers, who are the most skilful ore-sorters in the world. Only after false hopes have been raised will English and American operators realize that the 'ancients' were able to work as cheaply as the 'moderns,' despite the long transport on mule-back, the want of machinery and so forth, simply because their labour cost them nothing—the work was done by slaves. Only after a new concentrating mill has peen erected for the treatment of this accumulation of valuable but abandoned ore do inexperienced and over-sanguine promoters ascertain that there is nothing so difficult to sample as an old dump, and that the estimates formed on the basis of a casual examination or even a laborious inspection are apt to be vitiated by causes simple enough when exposed but deeply hidden from the innocent among mining speculators. But Mr. Nicholl estimates that "a net profit of £150,000 per annum can be obtained" without including the yield from these dumps or the ore in the Esmeralda property itself. This would be a yield of 100% on the captital to be issued—which is too much. The directors may go to allotment if £25,000 is underwritten, suggesting an amount of working capital wholly disproportioned to the extent of the property described. The vendors take £100,000, in cash and shares, but a contract disclosed in the prospectus suggests that the purchase price as far as indicated, was only £1800 in cash and £30,000 in shares for the bulk of the property. We note that the directors deemed it proper to cable to Mr. R. B. Symington at San Francisco for a confirmation of Mr. Nicholl's report, but this is scarcely impressive to an English shareholder who knows nothing of Mr. Symington. We happen to know the latter to be an engineer of honourable repute but even then we would consider his endorsement to be thoroughly unbusinesslike. Among the officers of the company is Mr. F. W. North, M.I.M.M., who is mentioned as the consulting engineer. It is proper to ask whether he has examined the mine and if so why are his estimates not given in the prospectus? If he accepted the appointment without any personal knowledge of the mine he has assumed a responsibility such as is inadvisable on the part of a careful engineer. Thus the Esmeralda Consolidated illustrates many of the errors prejudicial to success in the business of mining.

Mining in Siberia.

In our last issue we referred to regulations hindering mining operations on the part of foreigners in Eastern Siberia and expressed regret that the Russian authorities showed so reactionary a temper, in the face of the semi-official invitations to the investment of foreign capital in Siberian enterprises. We may go further, and deprecate the general attitude of Russian authority to mining undertakings initiated by Anglo-American operators. Of course, we are aware that there is a party in Russia that deems it the height of patriotism to shout "Russia for the Russians," a sentiment that is voiced daily in strident fashion by the *Novoe Vremya*, a newspaper that serves as a safety-valve for reactionary opinions and just now is particularly occupied in attacking the Lenskoie company for the sale of its controlling interest to a British corporation, the Lena Goldfields. But while a few irresponsible persons and journals may appeal to the latent dislike of foreigners that is the special prerogative of the ignorant, it is a fact that the Russian bureaucracy has in the main been favourable to accepting the aid of capital from other countries and has been generous in granting the concessions upon which many mining enterprises are based. Nor are the Russians the only people to confound patriotism with prejudice, for in California an effort was made to legislate against the tenure of land by aliens, but the bill failed to pass. The policy of the dog in the manger has been disguised before now by bigoted sentiment and it was 150 years ago that Johnson said that patriotism is the last refuge of a scoundrel. Sentiment apart, it is high time to ascertain clearly whether

Englishmen and Americans are to be deemed intruders or helpers, mere exploiters and exporters of the mineral wealth of Russia or developers of those resources and importers of the capital and ideas needed to animate industry. If the Russian cared for mining; if the money of Moscow and St. Petersburg were available for the development of copper lodes in Perm and Akmolinsk, or for the exploitation of the gold-bearing gravel in the valleys of the Amur and the Lena, then there would be no need to encourage the foreigner to undertake these tasks. But if outsiders are once admitted and encouraged to spend time and money in developing the mineral resources of the country, they are entitled to the fullest assistance—not regulations hampering them at every step and endangering the stability of their investment, but such laws as will conduce to efficient work and equitable dealing. Unfortunately mining in Russia is beset with conditions and obligations of antiquated origin, such as these: At Spassky the Government engineer, who acts as inspector, is empowered to appraise the value of the beef, flour, and other supplies sold by the English company to its employees; he makes this appraisal once a year, regardless of market conditions, so that the company at the present time is compelled to sell its stores at a heavy loss. On the Lena the Russian manager is authorized to receive a commission on the gross output of the mine—an arrangement conducive to rapid rather than to profitable exploitation. The miners help themselves to nuggets, but they are encouraged to sell the gold at half-price to the company, and it is estimated that they steal 23 *poods* or 800 pounds of gold per annum; this is equivalent to about £50,000, of which the company, by purchases, recovers about £20,000. The Government inspector can shut-down any mine by simply compelling the manager to comply with the exacting and absurd requirements as to timbering; thus the company is at the mercy of any inspector that happens to be either corrupt or stupid, and of the two types the second is the more dangerous. Here again it is only fair to say that the petty regulations in vogue in Russia compare favourably with the entire absence of State regulation of mining operations in such a region as Nevada, where men may be set to work in death-traps, or in Colorado, where the inspectors of mines may be chosen on account of a pernicious form of political activity. On the other hand, the Australian inspection of mines and State control of operations is effected by an excellent type of official and, in the main, to the benefit of the industry. In Siberia the ignorance of mining exhibited by those who are authorized to inspect and to control the operations is such as to be a continual hindrance to good work. An abnormally large staff of book-keepers is required to comply with the Government inquisition and a useless expense is imposed by the required maintenance of a mine-police or guards, besides the unintelligent interference from a mob of inspectors, sub-inspectors, and other petty officials whose business it appears to be to hinder rather than help efficient operation. And the annoyances are not all petty. We may quote the experience of Mr. Jafet Lindeberg, one of the most famous of Alaskan pioneers, who undertook exploration work in 1908 on the Volnarlarsky concession on the Anadir river and extracted about one *pood* or $10,000 worth of gold under a sub-contract from Mr. John Rosine, a partner of Colonel Volnarlarsky. Before he won this gold Mr. Lindeberg had spent $65,000 in prospecting, yet the *ispravnik* or police commissioner confiscated the gold, saying that it was the property of the Russian concessionaire. Thus the rights of the actual explorer and exploiter were set aside ruthlessly. Of course, the news of this outrage has done much to prejudice capitalists from venturing into northeastern Siberia. Such outrages ought to be made widely known in order that the more enlightened portion of the Russian bureaucracy may be moved to a reform of the regulations that impede the development of a vast mineral region. These belated ordinances constitute a real menace to intelligent industry; until they are repealed, followed by others based on modern principles, there will be no security for the foreign capital invested in Russian mines. At present the undertakings financed in London, Paris, or New York, are being conducted on sufferance, by concessions won by favour, by remission of conditions required by law, by courtesy of officials at St. Petersburg, and by other factors of a precarious and most unsatisfactory character. It is high time for all those interested in the development of the mineral resources of Siberia—and this includes the Russians themselves as well as enterprising foreigners—to unite in a concerted effort to obtain such security of tenure and such freedom of action as is not incompatible with the best interests of the country to the development of which they contribute their energy and their capital.

Mining and Metallurgical Society.

In April 1908 the Mining and Metallurgical Society of America was organized, in part as a protest against the nondescript membership of the American Institute of Mining Engineers, and in part to stimulate the discussion of subjects expressly avoided by the Institute, and finally to promote the solidarity of the profession by frequent local meetings. It was intended on the one hand to avoid the duplication of facilities for publishing technical literature and on the other hand to stiffen the moral backbone of the profession by the crystallization of opinion in regard to the ethics and customs of mining engineers, metallurgists, and geologists. The Society started with a nucleus of representative men and at once reached a membership of 100, which on January 1, 1910, had increased to 163, of whom 35 are geologists, 27 are professors, and 4 are editors. The other 97 are active mining and metallurgical practitioners. Of the several geographical divisions of the Society formed with a view to local meetings, only two have evinced any life, namely, New York and San Francisco. At Philadelphia one or two small meetings have been held, but the members living near Chicago, Denver, Salt Lake, and similar centres of industry, have failed to organize for purposes of meeting. At New York and San Francisco the attendance has not exceeded an average of a dozen at each monthly meeting. Despite the smallness of attendance and the lack of co-operation between the general body of the members, the Society has exerted a useful influence by expressing decided opinions in regard to company reports, the duties of consulting engineers, mine inspection, the Bureau of Mines, share speculation, and other matters having a vital bearing upon the business of mining. It is noteworthy that a deputation of the Society, headed by the president, recently waited upon the stock-listing committee of the New York Stock Exchange and submitted the resolutions passed—at an earlier meeting of the Society—with regard to the protection of mining investors. The resolution, and the members that submitted it, were well received. In another direction the Society has also done good work, for the American Mining Congress has been pleased to ask the Society to express its opinion and to formulate suggestions in regard to new laws regulating mine inspection. Thus it is apparent that the Mining and Metallurgical Society has won respect and has been able to exercise a beneficent influence. To complete this sketch of its career, we may add that Mr. H. S. Munroe was the first president: he is succeeded by Mr. J. Parke Channing. No better men could have been selected as standard-bearers. The new officers include Mr. F. W. Bradley as first vice-president and Mr. C. W. Goodale as second vice-president. Here also the excellence of selection is obvious. Mr. J. R. Finlay was the secretary and Mr. W. R. Ingalls was, and remains, the treasurer. As far as relates to the personality of its officers, the Society is peculiarly fortunate.

And yet the Mining and Metallurgical Society of America is a fiasco. It masquerades under a name far too comprehensive. No group of 160 men has the right to speak for the thousands of mining engineers, metallurgists, and geologists contributing at this time to the industrial development of the American continent. If there be not 1000 competent mining engineers and metallurgists, worthy to rank as properly qualified practitioners, then the mines and smelters of the United States, Canada, and Mexico are worse served than we had supposed. At the very inception of the organization it was proposed to issue a Blue Book of the elect; it is true that this proposal was killed, but apparently the spirit that animated the proposal, however well intentioned, lived to stimulate an exclusiveness wholly uncongenial to the main body of professional men in America. The Society has failed to be representative because it has aimed to be exclusive. Soon after it was started a number of men applied for membership, but most of them were black-balled. Among these were two or three men as fit as any of those already enrolled. Apparently a few egregious blockheads deemed that they could place themselves on a pedestal by limiting the membership to the select group who became charter members before a severe selective process has been set to work. The scandal created by the refusal to admit several first-rate men into the Society led to a revision of the by-laws, whereby the election of new members was transferred from the society as a whole to the executive council. Since then the proportion of applications rejected has been sensibly diminished, but the Society has not recovered from the irritation produced by the crude effort to be select by black-balling all applicants. Only 27 new members were added in 1909, and 8 members resigned, including two or three men of the highest repute. We note that the retiring president referred to the failure to enlist the many professional men that should be members of a society arrogating a national name. He said: "We have every reason to be proud of the character and attainments of our present members, but we have not, as yet, enrolled even a majority of the reputable and desirable engineers of the country." Speaking without prejudice, as one fortunate enough to be within the pale, the present writer deems it proper to lay stress on the wholly un-American sentiment that has led this new Society into a great blunder. The attempt of a fortuitous aggregation of individuals to sit in judgment on the members of a profession that includes thousands of men of varying education and occupation has failed utterly. In the effort to remedy the nondescript character of the American Institute membership, the new Society went to the opposite extreme. The result is to indicate the difficulty of applying any known process of selection. Thus, in justice to the Institute, and particularly its veteran secretary, it must be confessed that the generous policy is the better of the two, simply because, humanly speaking, no tribunal exists by which character may be weighed, abilities appraised, and accomplishment valued. Men who are fit today may be unfit a year hence; the man who blundered a few years ago may be among the most efficient now; the personal equation still remains an insoluble problem. A mining engineer is the man who does the work of the mining engineer; whether he does that work well or ill it is for a jury of his peers to decide; but who is to select the jury? No self-constituted tribunal can assume disciplinary powers. Among the charter members of the Mining and Metallurgical Society are several whom we, in the exercise of a most fallible judgment, would exclude; among those refused admission are several with whom we would be proud to be associated. The lesson is one that should be learned by all engineering societies; for example, by our Institution of Mining and Metallurgy. It is well enough to require certain qualifications and to promote homogeneity as nearly as possible, but it is easy to err on the side of hyper-critical requirement. Engineering societies arrogating national and even international guidance of world-wide professional activities must be representative before they dare to be exclusive. A professional organization is not a social club. An institution with only 1200 fully qualified members or a society of 160 is not warranted in the assumption that the one represents all the mining engineers, metallurgists, and economic geologists of the British Empire any more than the other can be permitted to assume to be spokesman for the thousands of professional men engaged in honest and efficient work on the continent of North America.

Standardization.

Continuing its useful labours, the committee on standardization appointed by the Institution of Mining and Metallurgy now issues a report on 'Bullion and Assay Values,' inviting alterations or additions. The purpose is to reform the careless and unsystematic usage of terms employed in describing the results of assay and analysis. The report contains six recommendations, of which five are so obvious as to merit instant approval. The first is that the amount of moisture in the sample shall be stated; the second, that in reports on gold and silver ores the ounce and decimals of an ounce or the pennyweight and decimals of a pennyweight shall be employed instead of the clumsy combination of ounce, pennyweight, and grain, and that fine metal, not 'bullion,' shall be designated; the third, that the yield from gravel shall be reported in grains and decimals of a grain of fine gold, or in pence or cents, per cubic yard, reckoning a grain as worth two pence; the fourth, that assay-values of cyanide and other solutions shall be expressed in parts by weight in a stated volume of the solution, the fluid ton of 32 cubic feet being recommended for use in connection with cyanidation; and the sixth, that in sizing tests the Institution's standard screens be used, or, if other screens be used, the widths of the apertures shall be stated. The fifth suggestion requires special attention. It is recommended that statements concerning the money-value of an ore shall be accompanied by the assay-value, together with an explanation of the calculations by which the former has been obtained from the latter. Here an index finger is placed on a frequent source of confusion, if not of imposition. In reporting the assay or analysis of an ore it does not suffice to give the proportions of the several constituents; it is necessary to explain in what form the metals occur and how they are combined with other elements, that is, the mineralogical constitution of the sample must be indicated because it bears directly on the commercial value of the product. When the samples sent to the assayer are in a crushed or pulverized state, the economic value of the ore may be completely masked. The most serious blunders may arise from deducing the value of an ore by adding together the values of the individual constituents; thus ores containing chalcopyrite, galena, and blende, all three together, or two only, are particularly liable to invite misleading inferences. One metal in an ore may so interfere with the metallurgical treatment of another metal as to render both metals practically valueless. Another matter deserving of attention relates to tin: We read in reports that an ore contains so many pounds of 'tin' per ton. This usually refers to 'black tin,' itself a term of the vaguest kind, for while it means cassiterite, we all know that the concentrate contains a variable percentage of tin oxide. The output of a mine is often given in tons of 'black tin,' but it is seldom that the actual metallic content is indicated. It is not possible to deduce the metallic content from the price, for that is influenced not only by the percentage of tin but by the presence of accessory metals detrimental to the quality of the tin. In this case, as in others, the lack of precision may be due to a disinclination to acknowledge the loss in concentration.

These efforts of the Institution to standardize usage are deserving of hearty support. We should like the physician to take some of his own prescription. The six brief recommendations as given in the latest circular are marked by verbal errors of a wholly unnecessary character. We shall not weary our readers by reciting more than two of them. In No. 3 "the assay value of alluvials is mentioned. 'Alluvial' is an adjective, to which the corresponding noun is 'alluvium.' The proper term is 'gravel.' In No. 2 it is advised not to make statements "in oz., dwts. and grains." Why the 's' after 'dwt.' and not after 'oz.'? 'Dwt.' is not an abbreviation, it is an apothecary's symbol and admits of no plural. Why abbreviate 'ounce' and 'pennyweight,' but not 'grain'? These may be small matters, but gentlemen who start on a campaign of standardization should remember that standardization, like charity, begins at home.

Speculation and Investment.

On another page we publish an article summarizing the results of the operations conducted by the nine most productive mining companies on the Rand. The biggest of these, notably the two largest consolidations, represent the attainment of what has hitherto been only a misleading phrase, namely, 'investment' in gold mines. In flaring prospectuses and in picturesque speeches we have been informed many times by promoters, financiers, and directors that certain mining 'investments' possessed all the safety of a manufacturing business, all the assurance of a gilt-edged bond, all the attractiveness of a national debenture. This has been merely a manner of speaking; in no case would a wise man have agreed to lock up his mining shares in a safe for ten years and in no case would a shrewd man have failed to see that the fluctuations in the price of such shares exceeded the rate of annual dividend; in other words, more money was to be made from the enhancement of the principal than from the receipt of the regular—or irregular—dividend. Here it is obvious that definitions are needed to clear the ground for intelligent discussion: the term 'investment' is used too often as a synonym for 'speculation'; hence the confusion of ideas not unwelcome to the promoter of risky enterprises. 'Investment' denotes the placing of money for a period in the expectation of receiving a regular income therefrom. 'Speculation' is the putting of money in a risky venture in the expectation of rapid gain. In the one case the element of time is involved, for 'investment' precludes the idea of buying today and selling tomorrow; further, the factor of safety is accentuated at the expense of the interest payable; the investor looks more to the protection of his principal than to the enhancement of its value; he has an eye to the regular dividend rather than to market fluctuations, even of a favourable character; he eliminates risk as much as possible and is content at the end of a period to receive his principal intact, having received interest regularly in the meanwhile. The speculator looks to a quick profit from a rapid rise in the market-value of his principal; the element of risk is distinctly involved, but the risk of a 'speculation' is compensated by the extra gain; the dividend is subordinated to the profit to be made by selling the share at a higher price, and becomes important mainly as it enhances the value of the principal; the 'speculator' does not care even if dividends cease, if for other reasons his shares appreciate. A notable case is Amalgamated Copper, which has been selling at $100 while paying 2% per annum and while subject to all the uncertainties of the copper market. Amalgamated shares are a counter in a gamble, the quotation bears no direct relation to the condition of the mines, and more money is made by 'bull' and 'bear' campaigns on the Stock Exchange than by extracting copper from lodes in Montana. Thus the final test between these two ways of using money is the 'lock up'; the 'investor' would be willing to place his securities in a safe for five or ten years, but the 'speculator' would be frightened by any such loss of opportunity to realize whenever fluctuations favoured a profitable sale. Applying these ideas to mining shares, it is obvious that they may be sane speculations, they may be insane gambles, but they are rarely 'investments.' But if we use these terms with discrimination we shall understand that a 'speculation' involves no idea of impropriety; on the contrary the use of money in speculative enterprise may be much more remunerative than in that safer employment of capital we call 'investment.' No human undertaking is absolutely devoid of the element of risk, and when a man recognizes frankly that he is 'speculating,' he aims to balance the bigger risk with the bigger gain. The chief danger lies in failing to distinguish between different degrees of risk and in confounding immobility with safety. We do not deprecate the adventurous spirit involved in 'speculation' nor do we wish to glorify the timidity that prompts 'investment,' but we do emphasize the essential differences between these two uses of capital. Thus it is apparent that mining shares are rarely investments; the fallible element is too strong, the accidental factor is too large, the estimation of ore reserves, the change in the character of the ore in depth, the facilities for blunders in the management, and other circumstances easily called to mind by those experienced in this branch of human industry, all tend to place a warning finger before those who use the word 'investment' unintelligently.

On the Rand, however, the comparative uniformity of the ore, the testing of the lode in depth by bore-holes and shafts, the large scale of the operations, the winning of a metal that is not subject to violent fluctuations of value, all unite in lessening the risks incidental to metal mining. Disturbing factors indeed are not entirely absent: the lode is occasionally faulted, and is less productive in such disturbed localities; the intersection of dikes may diminish the stoping area; fires, floods—above or below-ground—are not unknown; the labour supply is an occasional cause of anxiety, and so forth, but these elements are minimized by consolidating large mines into still larger properties covering a territory so extensive as to lessen the influence of irregularities of lode-structure and to permit of operations over so long a period of time as to decrease the effect of variations in economic conditions, until finally in such consolidations as the East Rand Proprietary and the Crown Mines we have shares that stand the supreme test, namely, they can be recommended to trustees acting for orphans and widows. We have at last evolved a kind of mining that amply fulfils the definition of an 'investment.'

Credit to whom it is due.

During February the Surprise mine in Rhodesia came into prominence by reason of the finding of a new orebody and it was officially stated that "the engineer" had inspected the mine, that "the engineer" had given certain facts, and that "the engineer" had performed other duties of a useful character. On enquiry we ascertained that "the engineer" is Mr. Walter Currie. In behalf of the profession and in the interest of the public we venture to protest against the unnecessary anonymity of the statements issued by the Surprise company. In matters of this kind the personal equation is everything; statements conveying technical information are only valuable if made by a technical man, and the value of them is increased when we know that they emanate, as in this case, from a thoroughly competent man. Engineers employed by companies are entitled to credit for their work; moreover, they should be saddled with the responsibility for it. In the public interest it is desirable that it should be known who makes a report concerning the development of a mine; if such a report prove accurate the engineer should be commended; if it prove incorrect he should accept the blame. We believe in the recognition of a personal sense of responsibility in mining affairs and in a concomitant distribution of credit to the members of the staff on a mine. In this connection we note with pleasure the action of the directors of such companies as those controlling the El Oro, Camp Bird, and Tasmania mines. At the recent meeting of the Tasmanian Gold Mining Company, it was made manifest that the managers, Messrs. John Taylor & Sons, and also their co-directors, desired fully to recognize the faithful and efficient services of the mine superintendent, Mr. C. F. Heathcote, who had been battling successfully against an excessive inflow of water and the difficulties incidental thereto. The chairman at the annual meeting proposed a vote of thanks to the superintendent and his staff. This shows a proper spirit. Mr. Heathcote is to be congratulated not only on good work well done, but upon the cordial support and appreciation of his directors, and the shareholders are doubly fortunate; such a spirit of co-operation is the best augury of efficient management.

Smelting by Solar Heat.

A project is on foot in the Transvaal for collecting the heat of the sun and using it for smelting purposes. The company owning the patents is called the Solar Smelting & Distillation Co., and the apparatus has been exhibited on top of one of the big office-buildings in Johannesburg. It is stated also that within a short time a 'collector' on a large scale will be tried at Doornfontein. This structure will be an iron framework carrying a number of curved metallic mirrors each approximately a quarter of a square yard in area. The apparatus will be mounted on rails on a circular track so that it can be made to follow the course of the sun and thus obtain the continuous benefit of the rays. This idea of utilizing the sun's heat has always been attractive and many enthusiastic inventors have sunk fortunes in it, the most notable having been Erikson, who designed a set of mirrors for the purpose of raising steam. It does seem a pity that prodigious sources of energy, such as solar heat and the tides, cannot be harnessed for the benefit of mankind, but in both cases the energy is in scattered form or, to use a simile from mining, too low-grade to present a commercial proposition. It is estimated by physicists that the direct heat of the sun in the tropics, without atmospheric interference, impinging on one square yard of surface is sufficient to raise 20 pounds of water to boiling point. Suppose the water is at 15°C to begin; then the pound-calories consumed in raising 20 lb. to 100°C will be 1700. Let us assume the temperature to be obtained in the smelting furnace to be 1500°C, and the specific heat 0·2, so that the pound-calories required to heat one pound to 1500°C will be 300. It follows therefore that one square yard of solar heat will heat 5·4 lb. per hour, and from this we deduce that 400 sq. yd. of 'collecting' apparatus will heat one ton of charge per hour. The latent heat absorbed in melting would increase the expenditure of heat by another 20%. In this calculation no losses are taken into account, due to absorption and dissipation of heat by the 'collectors' and by the atmosphere; nor have we included the energy required for heating the furnace itself. But the figures are sufficient to show that a large apparatus is necessary to produce substantial quantities of heat. Not only would such apparatus be large and costly, but the mechanism required in making it follow the sun would be cumbersome. This however is not the only economic question involved. A source of heat must be regular and dependable to be of practical service. How can we run a smelter continuously by means of solar heat? What about the alternations of day and night, winter and summer, sunshine and shower?

METAL MARKETS

COPPER.

The depression in the New York stock market and the appearance of financial trouble there early in the month produced its inevitable effect upon copper prices, and values fell rapidly until £59. 5s. was reached for three months copper. Producers, however, have held firm in the face of general abstention from buying by consumers, the small quantities required being supplied by the dealers who have more readily followed the fluctuations of the market.

AMERICAN COPPER PRODUCERS FIGURES.

	Jan. tons	Feb. tons
Stock at beginning of month	63285	43957
Production during month.....	52030	50318
Deliveries in U.S.A.	34892	29740
Exports..........................	36469	16684
Total Consumption............	71361	46424
Stock at end of month.........	43957	47851

The American Copper Producers figures showed the remarkable decrease for January of over 19,000 tons in the stocks held in America, both the consumption there and the exports to Europe having shared in the improvement. Such a noteworthy achievement seems to have taken the market quite aback as it was feared that much of the metal had simply been transferred to European warehouses. The erroneous nature of this impression has scarcely worn off even with the publication of the English stocks at the end of February, which shows an increase of only 2500 tons over the figures for the end of January. Speculators, however, seem slowly to be losing interest in the market and although there is no general increase in selling there has been still less inclination to increase commitments. The business with consumers has been small and featureless. No doubt the unusually large deliveries in January were partly taken in anticipation of February requirements, but even so, the demand has not reached what might be reasonably expected under the satisfactory trade conditions reported from all quarters. Recent American news indicates a still further revival in business. The conditions of the copper trade are so complex at present that it is more than usually dangerous to prophesy as to the future of the market, but conditions certainly point to a greater activity during March with prospects of hardening prices and a larger turnover.

Average prices of standard copper:

February 1910.	January 1910.	February 1909.
£59. 10s. 6d.	£61. 0s. 10d.	£57. 18s. 9d.

TIN.

Early in February it became apparent that the large increase shown by the January statistics was to have little effect on prices here. The Chinese holidays caused Eastern houses to withdraw from the market, and this, coupled with good buying on behalf of speculators and consumers, brought about a sharp rally, and in the second half of the month £152. 7s. 6d. was touched for near prompts and £153. 17s. 6d. three months. When this level was reached, profits were taken, and with a slackening in the American demand prices receded. The figures for February showed a considerable increase in American stocks and the quotation dropped to £147. 10s. for cash and £149. 7s. three months.

Average prices of cash tin:

February 1910.	January 1910.	February 1909.
£149. 13s. 0d.	£148. 3s. 6d.	£127. 15s. 3d.

LEAD.

Throughout the month the lead market has suffered from speculative realizations. A fair trade demand however has been an offset against these sales and prices have not suffered much. The tone of the market is steady, the quotations being £13. 3s. 9d. to £13. 5s. for soft foreign.

February 1910.	January 1910.	February 1909.
£13. 7s. 2d.	£13. 13s. 10d.	£13. 5s. 4d.

SPELTER.

Reports of trade in galvanized iron are still very satisfactory and works have full order books for months ahead. The demand for spelter, however, is restricted; leading consumers bought freely some months back and hesitate to again enter the market until the policy of the Syndicate with regard to future prices is declared. The premium for forward metal has run off.

Average prices:

February 1910.	January 1910.	February 1909.
£23. 3s. 1d.	£23. 4s. 2d.	£21. 8s. 9d.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Outside Gold Mining.—A reliable reflex of the activity prevailing lately in the various gold-mining districts of the Transvaal is provided by the official comparison of the number of prospecting claims held at June 30 in 1908 and in 1909. The figures stand as under :

	1908.		1909.	
(1) Johannesburg	14,615		18,147	
(2) Krugersdorp	21,378		30,349	
(3) Boksburg	21,184		28,660	
Total Rand		57,177		77,156
(4) Pilgrim s Rest	6,378		8,462	
(5) Barberton	8,039		6,995	
(6) Pietersburg	5,124		4,200	
(7) Klerksdorp	5,312		12,993	
(8) Heidelberg	9,019		12,279	
(9) Pretoria	657		56	
(10) Ottoshoop..	229		91	
		34,758		46,076
Grand Total......		91,935		123,232

The increase in the number of prospecting claims held on the Rand is notable and may be unintelligible tothose who are unacquainted with local conditions. It should be explained that there are certain broken portions of the Main Reef which have failed to be gold-bearing and over which claims are constantly being pegged and re-pegged by sanguine theorists. In addition, there is the uncertain line of extension southward of the Randfontein properties, giving the individual an occasional opportunity to obtain possession of a ' possible ' Main Reef property : and there are the numerous underlying and overlying 'reefs,' upon which there is often ground open for pegging in some parts of the district.

The Barberton ,Pietersburg, and Ottoshoop areas have clearly been out of fashion, while the Klerksdorp district has enjoyed a big wave of popularity. Klerksdorp is certainly getting a better chance today than it has for many years. Solid work is being done at the Africander, Rietkui ,West Bonanza, and Buffelsdoorn : and there is none of the wild excitement that has previously done injury to legitimate mining in Klerksdorp.

A Rich Strike.—The management of the Rand Collieries announces that " the 7th level drive north, after passing through a fault, encountered a solid body of reef, of which the full width has not yet been exposed, the 36 in. so far opened up assaying 21·3 dwt." The General Mining & Finance Corporation should by now have acquired sufficient experience in the administration of mines to be conscious of the culpable absurdity of such an announcement. If all the mines of the Rand commence announcing to the world every ounce section of ' reef ' encountered in development, on passing through a fault, they must publish their own morning papers to carry the news. And of course, all properly regulated firms must similarly announce when the first section beyond the fault carries 0·21 dwt., for the results are of equal importance. The investor in Rand Collieries who is unacquainted with mining conditions may be tempted to start calculating future yields from this 21·3 dwt. result ; the experienced investor may wonder whether 21 dwt. over 36 in. is not such a remarkable occurrence in the mine that it provides sound cause for the official jubilation—and a prompt selling of stock. Whichever way it is interpreted, it is a valueless piece of information and is mentioned here as an illustration of the foolish practice of some firms in announcing tit-bits of attractive news, in the belief that they thereby gain a reputation for ' frankness,' while they leave shareholders in the dark as to the more vital aspects of development progress. The declaration of a single assay along a drift can carry no weight with engineers. For all they know, it may have been taken by an Aberdeen sampler on the morning after a ' nicht wi' Burns,' and however accurate, its influence is almost nil in a thousand feet of reef exposure.

Accidents.—Government statistics show that the accident death-rate on the Rand was abnormally high during the year to June 30, 1909, standing at no less than 5·29 per 1000. The average was adversely influenced by the flooding calamity on the Witwatersrand Gold Mining Co.'s property in January, 1909, which accounted for 150 deaths. But excluding this, the rate still stands at the unquestionably bad average of 4·5 per 1000. The matter has naturally occasioned comment from the Inspectors of Mines, who look at things from an impartial point of view and whose conclusions and recommendations, if not always of practical value to managements hard-pressed to diminish costs, should prove beneficial. Mr. Fergusson, the Germiston Inspector and a leading authority on the question, points to the well-known fact that the miners are warned of the approach of the Inspector and make unusual preparations, "being free to continue their lawless practices, as soon as he is out of the mine." "Lawless practices" is rather suggestive of blowing-up lazy natives with gelatine or setting fire to an unfriendly neighbour's dynamite box; but the "lawless practices" certainly cover many faults of omission which could only be rectified under a system of constant or surprise inspection. So Mr. Fergusson declares that the only possible way to make the workmen more careful is for the mine officials to act as inspectors and report every breach of the regulations that comes under their notice. He declares that managers are now more careful to enforce the regulations; this conduces to an improvement, if not in the death-rate, at least in the number of workers in hospital through minor accidents. Mr. Bottomley, the Krugersdorp Inspector, follows a different line of argument and heaps unsparing censure on the carelessness and inefficiency of the new class of miners, who are "replacing the old." The knowledge of mining possessed by the modern Rand miner is said to be gained solely by "spending a few hours a day for a few months in a stope and watching natives at work." Mr. Bottomley draws attention to an increase of accidents due to fall of rock and recommends the appointment of hanging-wall inspectors by the mines. Mr. Vaughan of Boksburg has a bad word to say for the influence of the present strenuous conditions: "Where everything is rushed to secure the greatest possible output for the least cost, accidents increase in number." While this theory is attractive, the application of it must be considered in detail before our hands go up in horror. Maximum output at minimum cost should be the aim on all mines, of whatever capacity. But whether the exploitation of big areas with big units tends to greater danger is a debatable question; in fact, Messrs. Fergusson, Bottomley, and Vaughan might well be left to discuss the matter themselves. The first named complains of the difficulty of making surprise inspections. The bigger the area, the better the chances, however, of the previous warnings getting round. The second named concentrates his blame on the ignorance of the individual miner, whose intelligence is not likely to be materially increased by the incidence of small claim-areas or the fineness of the mesh in the battery-screening. But when the rush for ore leads to carelessness in mining or supervision, it is not the demand for low costs that is at fault, but the false economy of the method adopted in seeking them.

Van Ryn Deep.—The announcement of profitable ore being struck in the East shaft of the Van Ryn Deep, at 1617 ft., supports the opinion expressed by me last October as to the folly of taking a gloomy view of the unprofitable results in the West shaft. The Van Ryn Deep is too well situated to be prejudiced by the first assays of the ore cut in a shaft and it is certainly too heavily capitalized to warrant the big fluctuations recorded in the price of shares, following the publication of good and bad results.

New Modderfontein.—The details of the New Modderfontein scheme of expansion have been well received on this side, for the better engineers are acquainted with the district, the more easily can they understand the merits of the proposal, which, however, would have been regarded as foolhardy a few years ago. The acquisition of the water rights as a mining area, the development in the eastern portion of the Modderfontein itself, in the Modderfontein B to the east, and in the Brakpan to the south-west are all factors giving strength to the bold scheme of excess development and extension of reduction plant advanced by the consulting engineer. From the standpoint of claim-area alone such a policy was justified long ago, but other conditions have hitherto been lacking. Knowledge concerning the ore-bearing character of the eastern portion of the Rand was insufficient and the mine workings generally were not in shape for the commencement of any great scheme of advanced development. The policy will involve the introduction of mechanically equipped main haulage-levels between the eastern and western ground. Speaking of underground mechanical haulage, it may be mentioned that the electric system is said to be running satisfactorily in the Geduld, where it has been introduced for the first time on the Rand, and where the ore-bed has a similarly flat dip.

Technical Impressionism.—Walter Mac Dermott, who is visiting the Rand in connection with the change in local management of Fraser & Chalmers, is greatly in request to attend technical dinners and meetings. The call for his attendance has evidently been made by those acquainted with his wit as well as his knowledge. Upon the occasion of the South

African Association of Engineers monthly meeting it was announced on the agenda paper that he would give some of "his first impressions" of Rand mining and metallurgy. Apparently the matter was arranged without consulting the person chiefly concerned, but Mr. MacDermott was quite equal to the occasion and gave an excellent parody on 'impressionism' (before proceeding to more serious topics) by declaiming that—purely as an impression —it appeared to him the most interesting development in Rand practice was the scheme now on foot for drawing power from the Victoria Falls, and using it for elevating the tailing to the smoke-stacks, which were to be given bell-mouths and used for the hydraulic filling of stopes. As a caricature of modern 'tendencies,' this happy jumble would be difficult to exceed.

South African Tin Mines. — The Doornhoek property of the South African Tin Mines is not the most productive nor the richest of the few tin-producers in the Waterberg district, 100 miles north of Pretoria, but it is one of general interest. The equipment is one of the best in the region. The general view published herewith is taken looking north, and shows the incline-shaft sunk on the fissure vein, cutting northwest through the metamorphosed shales, which dip north at 45°. The shaft is now down 275 ft. and driving has disclosed no pinching or faulting. A grade of 2 to 3% tin oxide has been estimated. The plant comprises a 10-stamp battery with heads weighing 1350 lb., spitzkasten, two Wilfley tables, four Frue vanners, a buddle, a small tube-mill and a roasting-furnace. An air-compressor rock-drill plant and slime tables are now being put in. The capacity of this plant is 35 tons per day.

Doornhoek Tin Mine.

Tons to a Claim.—At the annual meeting of the Jubilee company, one of the oldest central Rand mines, of small area and complete independence (together with the Salisbury) of "big controls," reference was made to the remarkably high tonnage of ore produced per claim (64,025 square feet). Owing to the steep dip and big ore-widths, this produce works out at an average of 89,138 tons per claim. The general manager expressed the view that this is a record for the Rand. It is certainly a record for an entire mine, but there are probably portions in the Robinson where a greater tonnage is obtained from an equal area. In some parts of that portion of the Rand, there are found South Reef stopes 5 ft. wide, Main Reef Leader 8 ft. wide, underlaid by Main Reef 7 ft. wide, giving a combined stope-width of 20 ft., which at 35° dip and with a 10% deduction for faults, dikes, etc., represents 117,000 tons of ore per claim. Taking the Rand as a whole, the tonnage per claim probably averages 30,000 mine-tons or, with allowance for sorting and unprofitable rock, say 20,000 mill-tons. When the East Rand influences the average more weightily, the tonnage per claim will be lower.

End of Electrolytic Precipitation.—The Lancaster West Co. has just completed the new extractor-boxes for the zinc precipitation process, and the change from the Siemens Halske system will be made immediately. This transition represents, I believe, the final abandonment of electrolytic precipitation on the Rand. For some years before the War, the process had keen support, and many of the journals of the scientific societies indicate the great weight of opinion in its favour, owing to the saving in cyanide and the fineness of the bullion produced, even though it cannot be said to have ever gained a position of equal popularity with the zinc method. Under present conditions, with the improved efficiency of zinc precipitation and clean-up arrangements, the Siemens plant has had no chance of support, except in the case of the Lancaster which, until recently, feared the capital expenditure involved in the alterations. With the closing down of a neighbouring mine—the Champ d'Or—another relic of the pioneer days will pass away in the shape of square sand-vats.

TORONTO.

The Porcupine Lake goldfield is still well in the foreground of public interest. The influx continues unabated and active development work is in progress on many claims. The Ontario government is laying out a new townsite at the northeastern end of the lake and has created the new mining division of Porcupine with a local record-office for the convenience of prospectors. Many locations have changed hands at high figures, the largest deal of the kind yet made public being the sale of the Wilson claims, comprising 11 locations about two miles southwest of Porcupine Lake, to McCornick Bros., of New York, for $1,500,000. At the end of January, a sensation mildly resembling that created during the Cobalt boom by the action of the Guggenheims in throwing up their option on Nipissing, was caused by M. J. O'Brien abandoning his option on the Miller claim for $300,000, after having made a payment of $10,000 and put down a diamond-drill 130 ft. Being dissatisfied with the result, he offered to complete the deal at the reduced price of $100,000, but this was refused. The adverse impression caused by this incident was not, however, permanent, as Mr. O'Brien has secured other properties, which he is proceeding to develop, having recently paid about $110,000 for four claims near the Bannerman group, where a large force of men is at work. The greatest progress in development work has been made on the properties held by Henry and Noah Timmins, of Cobalt celebrity. One shaft is down 38 ft. While the free gold disappeared at 10 ft. and was replaced by sulphides, at 28 ft. quartz veins showing free gold were again encountered. The consensus of opinion among scientific observers is that no showing of free gold in the surface quartz can be taken as indicating the merit of the district, as experience goes to show that free gold is apt to disappear a short distance below the surface. It may or may not give place to sulphide ore. The presence of the latter and its degree of richness is the only test. In any event, operations will require heavy investment of capital long before any returns can be expected, so that no comparison can be made between Porcupine and Cobalt, where the cheap and crude methods employed at the outset were speedily remunerative and provided the funds for more systematic working. The Scottish Ontario Mining Co., organized by the Glasgow firm of J. S. MacArthur & Co., represented on the ground by Peter McLaren, holds six of the Bannerman claims and is arranging for the instalment of a modern plant including a 10-stamp mill. Buildings are in course of erection and the ground is being cleared for the sinking of two shafts. The quartz lodes on these properties average 6 ft. in width, and the average of several assays runs about $200 per ton. So far there has not been much 'wildcatting' in the form of placing cheap shares on the market in connection with Porcupine; this is largely due to the shyness of the oft-deluded public, which just now looks askance even at good dividend-paying mining stocks, and in some degree also to the greater vigilance shown by the Government in prosecuting offenders. The most glaring instances of wild-cat flotation lately have been a couple of oil companies formed to operate in Alberta, taking advantage of the genuine discoveries made by Alfred Von Hammerstein. A fine of $200 in one case and $100 in the other put them out of business.

Cobalt.—It is the same old story of waiting for the arrival of cheap power promised from month to month, but still in the uncertain future. Shipments from a few leading mines are being well-maintained, but generally operations are slack and public interest in the market is waning. At the La Rose mine a force of over 200 men with 10 large drills and 12 small ones is at work. A large stope is being taken off the roof of No. 10 vein from the level 75 ft. below the tunnel level, at which depth a good ore-shoot has been developed. On No. 3 vein a drift for several hundred feet at the 135 ft. level shows an average 3 in. of high-grade ore. Stoping is also being done on the 75 ft. level of the McDonald vein along a 250 ft. ore-shoot. The Lawson property of this company is yielding well and undergoing active development. At the annual meeting of the Crown Reserve on January 26, it was announced that the regular dividend of 24% and bonus of 36% would be paid during 1910. The surplus at the end of last year amounted to $549,275, and dividends to the amount of $1,238,169 had been paid. Profits on operating amounted to $1,436,398. The Trinity Cobalt mine has been sold under liquidation to Henry E. Jungling, of Buffalo, for $12,500. The McKinley-Darragh is getting satisfactory results from its new concentration mill with a capacity of 80 tons of ore per day. An extension is being made, increasing the capacity to 120 tons. The Cobalt Lake is taking rich ore from the new veins at the south end of the lake near the McKinley-Darragh boundary. One of these shows 5 in. high-grade ore. A winze is being put down from the 190 ft. level to the 250 ft. level and an adit will connect with the other veins and the shaft at this point. The annual report of the Trethewey shows that receipts were $347,864, and that dividends to the amount of $244,545 have been paid. The Right of Way has struck a new rich vein in a cross-cut on the 120 ft. level about 500 ft. from the shaft. It is 4 in. wide and runs about 2000 oz. silver per ton.

Gowganda. — Shipments are now being steadily made, the total consignments since January 1 amounting to 124 tons, of which the Blackburn contributed 60 tons and the Reeve-Dobie 62 tons. The Burke-Remey sent a test shipment of 2 tons to the Chippewa smelter.

Steel Industry. — Some significance is attached to the recent visit of Andre Weill, of Paris, who is connected with the Creuzot steel works, to Ottawa, where he has interviewed many leading public and business men and inspected a number of water-powers. It is understood that his company is investigating the possibilities of the steel industry in Canada, with a view to establishing a branch to undertake electric smelting.

MEXICO.

General Activity.—It would seem almost incredible that, in a mining district so old and so thoroughly developed and exploited as Real del Monte, any superficial indications of a large body of valuable ore could have been overlooked during the past 250 years; and yet recently a denouncement has been made of 30 pertenencias or claims covering 36 hectares, under the title of Santa Margarita. Andres M. Corral of Pachuca is the engineer in charge of the survey. Indeed, the number of denouncements of new properties and of abandoned mines and *antiguas* is quite remarkable, and must surely indicate that we are on the eve of a real revival of mining in Mexico. Further denouncements of 200 pertenencias were made at El Cerro de la Cebada, in the district of Zimapan, under the title of San Alberto, by A. G. Dixon, a resident of San José de Oro. Similarly 400 pertenencias have been taken up near the village of Santa Gertrudis in the same district, under the title of San Alfredo. An equal area has been taken up at Encarnación, in the same district, under the title of Santa Maria. The various claims include veins carrying gold, silver, copper, and iron. J. Hynn has been appointed engineer. A denouncement of 5 hectares has been made, under the title of Tres Niñas, at Las Huertas in the district of El Chico near Pachuca. Miguel Cerro is the engineer appointed. The vein carries gold and silver. In the State of Guanajuato there have been more denouncements recently than usual. It is stated that in the State of Hidalgo during the last two months, applications for mineral lands have been made to the extent of 3000 pertenencias; this is largely due to the building of the Pachuca-Zimapan railroad, work on which is now being rapidly pushed forward. This line is opening up a territory known to be rich in gold, silver, copper and iron mines, but never developed owing to lack of transportation facilities. These facts suggest the widespread stimulus to mining due to railroad expansion.

Old Mexican Mining methods.- The tenatero and the chicken-ladder.

The Santa Gertrudis company is now liquidating its affairs as the result of having sold its properties to the Camp Bird Co. and has just declared what will therefore be their last dividend, No. 432 of 50 cents per share, until the final completion of the liquidation. The final payment by the Camp Bird company was made to the Santa Gertrudis Co. by a cheque for 9,144,825 pesos on the Bank of Montreal. We understand that the design for the new mill is already under way. The mortars will be 16 in number, of the single-discharge type, arranged with extra heavy base to rest direct on concrete mortar-blocks. The holding-down bolts will be arranged as angle-bolts and will pass each other in an X under the base ; to permit of this arrangement, the bolt-holes will be staggered. The mortars will be equipped with liners. All the various contracts that were pending by the Santa Gertrudis Co. have been taken over and ratified by the new owners. The total amount of stamp-duties paid to the Mexican Government on account of the transfer will amount to approximately 63,000 pesos. Hugh Rose has been appointed general manager.

English Management.—Another example of the failure of English management in Mexico came to light when W. F. Turner presiding at the meeting of the Anglo-Continental Gold Syndicate, recently held in London, stated that they had decided to write off £50,000 to profit and loss, as a result of the failure of their Santa Maria mines business; he further stated that the losses were principally due to the protracted litigation, which had been the curse of the business, and for the present they were out of Mexican mining, although they continued to hold some leases north of Zacatecas.

It is reported that John Taylor & Sons, of London, will again become interested in Mexican affairs, their assistance being sought to revise the Torres-Cherokee enterprise ; they are also said to be taking an interest in some properties now held by the Mexican Mines Prospects Development Co. They have also taken an option on a property belonging to Maurice Clarke in Oaxaca. It is interesting to remember that the founder of this house made the first favourable report on the Real del Monte mines, as the result of which that property passed into English hands in the early part of the last century.

Bank failure.—The collapse of the United States Banking Co., better known in Mexico as Ham's Bank, has been a serious blow to many companies and individuals. The failure seems to have been due to gross mismanagement, and judging by local reports, a condition has been revealed that must have indicated disaster for over a year past. Efforts are being made for reconstruction, which, it is hoped, will be effected. This failure, which runs into many millions, is seriously affecting the confidence of wealthy native investors. It seems to have been entirely due to causes within the circle of the Bank's administrative board, and not to any general condition of panic or depression in Mexican financial circles ; and is therefore all the more unfortunate as business and enterprise were steadily reviving. The failure of the bank has been followed by the liquidation of the National Markets or as it is better known the Popo Packing Co. It is claimed that each of these institutions is responsible for the other's downfall, though, as a matter of fact, re-organization and a capable management is all that is required to place, at any rate, the latter business, on a paying basis.

The production of gold in Mexico during the year 1908 to 1909 amounted to 45,014,954 pesos in value, as follows :

Gold bullion exported.........	36,544,545
Gold in ore and other mineral products exported..........	2,633,145
Used in Mexico	5,837,264
Total, in pesos...	45,014,954

A notable increase is shown in the last two decades, for up to 1891 the production of gold has never exceeded 2,000,000 pesos per year. The value of coal produced was 4,400,000 pesos ; petroleum products totalled 2,800,000. Silver, exported in all forms, including bullion, ore, concentrates, and precipitates, amounted to 73,741,312 ; the silver used in the country was 3,334,784. Thus, the total silver production was therefore 77,076,096. Including the base metals, the total of the metal and mineral productions in Mexico for the year was 160,400,158. In every case the figures refer to pesos, worth 50 cents American.

There seems to be a probability of a still greater output in gold, iron, and coal, during the course of this year, as the protective freight-rates in favour of native coal-mining are having their effect, and the steady increase in gold mining also is noteworthy, and it seems probable that some of the large low-grade bodies of gold-bearing quartz, known to exist in Guerrero and Michoacan, will soon be developed.

As already stated the production of gold in 1890 was about 2,000,000 ; and in 1895 it had reached 10,000,000 pesos. In 1904 it exceeded 20,000,000. Just about this time the currency reform was introduced, and since then the production has steadily increased.

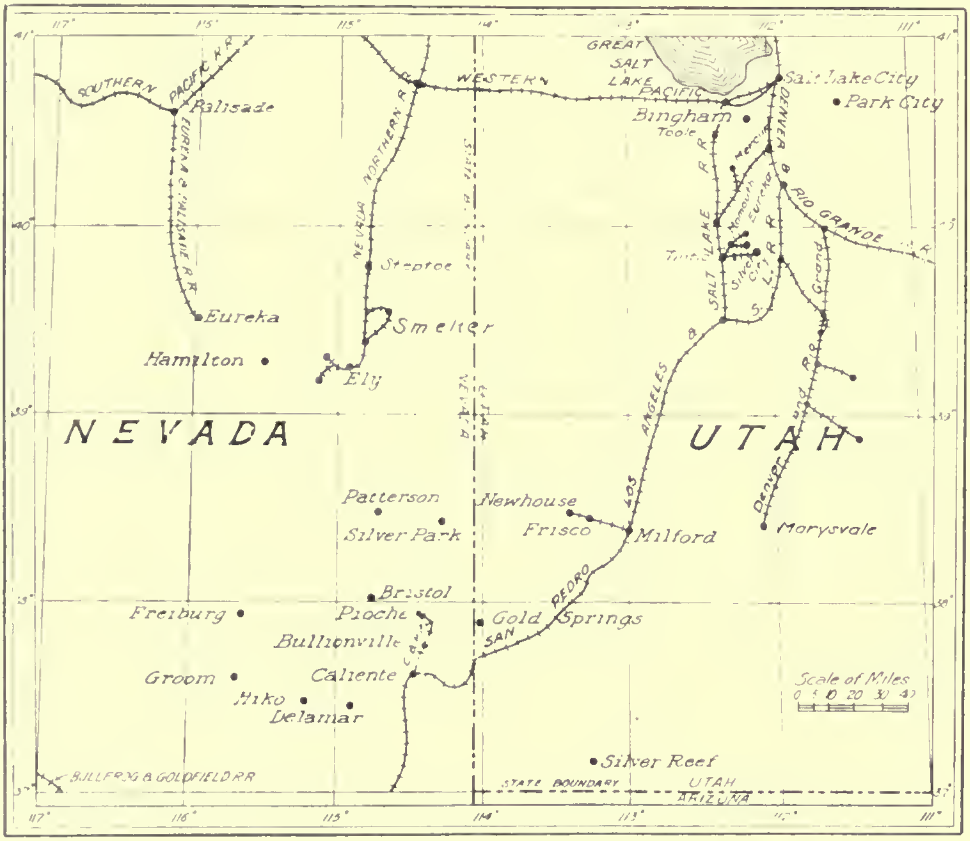
Chihuahua.—It is reported that the Exploration Company has paid $150,000 toward the purchase of the San Gregorio, a small property adjoining the La Vieja, which belongs to the A. S. & R. Co.

[This is not confirmed at the office of the company mentioned.]

SAN FRANCISCO.

Copper.—Rumours of panic again come from the East. The *Boston News Bureau* presents an impressive list of copper shares showing that between high-level prices in 1909, and early in February of this year, 35 stocks have shrunk in market value $201,000,000. Of this total shrinkage Amalgamated and the Cole-Ryan stocks have suffered 46%. North Butte has dropped from 89¾ to 30; Utah Copper from 66 to 46; Calumet & Arizona from 130 to 66; Amalgamated from 96 to 75; and even Calumet & Hecla from 700 to 615. There has also been a marked lowering in the price of standard industrial stocks, though here the fall has not been as great as in the much discussed 'Coppers.'

A variety of reasons has been assigned for this fall in prices. On the one hand it is gravely stated to be the result of capital's timidity in the face of an expected decision of the Supreme Court adverse to the Standard Oil and the American Tobacco companies, together with Mr. Taft's announced determination to allow no cessation of the efforts begun by Mr. Roosevelt to break the illegal 'trusts.' On the other hand it is regarded as a carefully staged 'rich man's panic' intended to impress the President with the impolicy of interfering in any way with the plans of Wall Street. So far as relates to railway and industrial stocks, the truth probably lies somewhere between these extremes. Doubtless many investors and professional speculators have discounted the effect of an adverse court decision and doubtless, also, there has not been the united effort to support the market that might have been expected had not Mr. Taft been thought to be in need of an object lesson. As to the 'coppers,' however, the explanation is much simpler. The brutal truth is that copper stocks have been selling above their real value, and that the fact has become known through the



THE COPPER DISTRICTS OF UTAH AND NEVADA.

discussion of the proposed copper merger and the bitter fight waged by James Phillips, Jr., against the consolidation of Nevada Con. and Utah Copper. Despite persistent efforts of insiders to support the market, prices have naturally fallen all round. It may be instructive to quote a few instances of over-valuation, taking for that purpose the companies that are expected to be associated with the new and greater Utah Copper. The details of the estimates are given in the *Mining and Scientific Press* of February 19. In each case the ore reserves, recovery, and costs are based on figures supplied by the company or by some one associated with it and are probably more favourable than would be assumed by an outside investor. Despite this, the present value, assuming only a return of 7% and re-investment of dividends at 4%, is in each case materially below present selling prices.

	Selling Price.	Present Value.
Utah Copper	$48\frac{5}{8}$	$31·00
Nevada Con.	22	17·17
Ray Con................	$22\frac{3}{8}$	20·26
Chino Copper.........	$11\frac{1}{2}$	8·40
Miami Copper	$23\frac{3}{8}$	15·34

Of these five properties only the Nevada Con. and Utah Copper are producing. The estimates are based upon $13\frac{1}{2}$ cent copper, and as to the future price of the metal it can only be said that belief in a higher price must be based on esoteric information. While recent American figures show improvement in the matter of surplus, there is reason to suspect that this is largely fictitious and due to transfer of the metal to European speculators.

Wall Street is playing an increasing part in mining. More and more it dominates the situation. The necessity for large capital in order to develop the low-grade deposits, particularly of copper, together with impatience at the slow methods of earlier days, gives the Eastern financiers who have large liquid assets a tremendous opportunity ; of which they are availing themselves on every occasion. There still remain many good gold-silver properties and even small but rich copper and lead-silver mines that may be developed largely by the old method of making the mine pay for itself; but if, as is seriously proposed, 1% copper ores are to be worked within five years, outside capital must be attracted in large amounts and the simple way to do this is the Wall Street method of always booming shares to a premium immediately after organization of a company. This at least gives each subscriber a chance to unload and supplies money to the mines, however disastrous it may be in the long run.

Consolidation of properties continues, despite all criticism. The new Utah Copper has taken over at least a large part of the Nevada Con. stock. Anaconda is to swallow its late owner, the Amalgamated, and as many other securities as it can digest without excessive torpidity. At Park City, Utah, negotiations have been under way for some time looking to the joining of the Silver King Consolidated Mining Co. and the Silver King Coalition Mining Co. The immediate occasion for the merger is a dispute over titles to certain bodies of ore. The Consolidated company claims that the Coalition has extracted several million dollars worth of ore from Consolidated ground. The Coalition claims that the ground in dispute is jointly owned and that in any event the cost of extraction has been more than the value of the ore. There have been many unsuccessful attempts to buy the Coalition, but it is understood that at last a price has been named to the Consolidated company and that a sale is probable. The control is in the hands of David Keith and Thomas Kearns. The mine has been a steady producer since 1890 and has yielded upward of $25,000,000, of which $12,000,000 has been paid in dividends. In addition, a million dollars has been invested in plant including a 300-ton mill. The ores are silver-lead with some copper and gold. It is reported to average $45 per ton and the present reserves are said to indicate a life of 10 years. The mine has never been troubled with water and is opened by a shaft 1300 ft. deep and an adit two miles long. The Silver King Coalition Mines Co. is paying quarterly dividends of $187,500.

United States Smelting.—A much more satisfactory form of consolidation is instanced in the purchase by the United States Smelting, Refining & Mining Co. of the Needles smelter in San Bernardino county, California, and the Tennessee and Empire mines in the Chloride district of the adjoining county of Mohave, in Arizona. The smelter, which has stood idle for some time, includes one lead and one copper furnace. This equipment is being put into condition for operation and within the next few months is to be supplemented by the building of an additional lead furnace and a 100-ton concentrating plant. The improvements will bring the capacity up to 400 tons of charge per day. The re-opening of this furnace will be of marked benefit to the region and will permit the working of a number of small properties in western Arizona and southern California which under existing conditions could not show a profit. It is also announced that F. M. Smith and associates have decided to open the Mount Blanc borax deposits where material can be obtained at a cost of 50c. per ton in place of $1·50 at the Lila C. mine, the present source of supply. Considerable development is taking place at a number of points in this region and the advent of a strong company such as the U.S. Smelting, Refining & Mining, is welcomed. The growth of this company has been striking. It was organized in 1906 as a holding company, and took over by exchange of shares practically the entire stock of the United States Mining Co., United States Smelting Co., and Mammoth Copper Co. It also controls important lead-silver mines in the Tintic district, copper mines in Bingham canyon, zinc mines in Wisconsin, the Real del Monte at Pachuca, Mexico, the Peruvian M. S. & R. Co., smelters and refineries at Midvale and Bingham Junction (Utah), Kennett (California), Grasselli (Indiana), and Chrome (New Jersey). It is prepared to handle a wide variety of ores and has always followed the policy of entrenching itself by ownership of mines as well as smelters. The company has operated quietly but has been managed with discretion and is an important competitor of the A. S. & R. and International companies.

Northern California has not been asleep while the southern counties bathed in the warm sunlight of prosperity. The various contestants for ownership of the Sixteen-to-One mine at Alleghany in Sierra county have compromised their differences and organized a new company to work this famous producer of high-grade ore. The Champion Gold Mines Co. has been formed with a capitalization of $5,000,000 to operate the Champion group of mines near Nevada City. These mines have long been vexed by litigation over apex rights and more recently have suffered from lack of working capital. They are credited with a total production of approximately $25,000,000, and it has been an open secret that they afforded the most obvious basis in Nevada county for another great mining success such as that achieved at the North Star and Empire nearby. The main work has heretofore been done at a depth of less than 800 ft., though some workings extend to 1600 ft. The mill assays run about $12 per ton and concentrate worth $65 is made. Abundant water-power is available and as the vein is well defined, reasonable working costs should be assured. Near Grass Valley the Idaho-Maryland is sinking a new double-compartment shaft, and the Pittsburg-Gold Flat Mines Co. is actively at work at the Pittsburg, Gold Flat, and Potosi mines, which were brought into combination in 1908. In Shasta county, the copper mines are busy and progress is being made in the negotiations with the farmers regarding smoke damage. Agreement has been reached between the Shasta County Farmers' Protective Association and the Mammoth Copper Mining Co. as to the matters to be incorporated in the complaint for a friendly suit before the United States Circuit Court at San Francisco. The agreement covers also the answer to the complaint. In addition it is announced that a bag-house will be in operation by July 1. In time it is expected that all substantial damage will thus be eliminated or compensated and the two great industries will work in harmony.

Nevada finds it difficult to turn her attention even for a moment from 'the greatest gold mine of the world,' as the Goldfield Consolidated is proudly proclaimed. Nevertheless, the old Comstock is coming in for some attention as a result of metallurgical improvement by Mr. Butters and the unwatering of old workings under direction of Mr. Whitman Symmes. Despite discouragements with the electric pumps, enough ground has been recovered to allow exploration of new territory east of the old workings, and with most satisfactory results. Arrangements have just been completed to extend the pumping agreement to cover the south end of the lode. More than 4000 feet of ground will be unwatered to an additional depth of 400 ft. in a locality that has produced over $100,000,000. A drift will be run from the 2100-ft. pump station at the Ward shaft toward the Yellow Jacket mine for a distance of 200 to 250 ft., when old workings will be tapped by diamond-drill holes. At the shaft the water will be pumped to the Sutro Tunnel level and sent out in a wooden pipe. One of the chief objects of the work is the exploration of the 1700-ft. level of the Yellow Jacket, Crown Point, and Belcher, where rich ore was left at the time the miners were driven out by the Exchequer flood. Popular interest in this work is increasing.

Labour is a bit restive, an excellent sign of good times. The Homestake mine, in South Dakota, is working at about half capacity with non-union men exclusively, and so far without any riots or other trouble. The Black Hills district has so long been free from such disturbance that it is hoped peace may be preserved throughout. The other mines have joined the Homestake in refusing to employ union men. In the coal regions farther east negotiations are now on between the United Mine Workers and the Coal Operators associations, for a wage scale covering the two years beginning April 1. A demand for an increase has been made recently by the miners, and as the operators have not been able to supply coal fast enough to prevent actual public suffering, it is likely that wages will finally be raised. There must needs be, however, the usual prolonged negotiations and not improbably some 'stoppage of work'—a polite euphemism for something that neither side will admit is a strike or a lock-out. However, by April the active demand for coal will be satisfied and operators can well afford to take as much time as they desire for negotiations.

Federal legislation regarding mining and mineral lands continues to attract attention and excite controversy without making any striking progress. The House has passed the bill providing for a National Bureau of Mines for taking up technological investigations. Whether the Senate will agree is as yet uncertain. The President's recommendations regarding conservation seem destined to be mauled, if not maimed, though doubtless some legislation will pass. Probably his authority to create reserves will be made definite, and separation of surface from mining rights in coal lands be brought about. It clearly is too early to hope for the thorough-going revision of our mining law that is so much needed and desired.

MELBOURNE.

The Coal Strike at Newcastle is still paralysing the industrial world of Australia. The resulting difficulties, however, will soon be at an end, for now the big supplies of coal ordered from India, Japan, and Great Britain are beginning to arrive. As an example, the Melbourne Metropolitan Gas Co. ordered nearly 40,000 tons from London. The absolute indifference of the Newcastle miners to the wants of the public has exasperated everyone. Peter Bowling, the leader, has been sent to gaol for a year, and others of his associates have been fined £100 each for speeches that would tend to incite trouble. They will have to pay or go to gaol, and the hat is being sent round for them, but so far with slight response. Viewed in a large way, the unionist has every reason to condemn the miners. The cause of unionism heretofore had been handled so skilfully that Australian industry had to accept it. People do so well in Australia and move ahead so fast that they have come to regard even militant trade-unionism as almost a part of their industrial and political organization. But the advent of Bowling lifted the veil and showed what was behind. Then it was found that the majority of the miners at Newcastle wanted possession of the mines. Nationalization was the term employed, but it was not of the type understood by the average worker. It aimed to place the coal supplies of the country in the hands of the Newcastle bosses: even if this has not been openly stated, the purpose was well understood. Now, as the result of the strike, unionists generally are saddled in New South Wales with a piece of repressive legislation so drastic that the labour leaders have to walk about in couples or discuss in secret matters connected with the strike. All the moderates are storming and raging, for they see the work of half a century threatened. Knowing how politicians follow the leader, they are aware that, with the example of New South Wales before them, similar legislation will be enacted in the other States, should anything like a general strike be attempted in the future.

State Coal Mining.—The scheme of the State coal mine in Victoria is being unfolded. George H. Broome, who opened up the State mines in New Zealand, is to take charge of operations. The present output of the mine is 300 tons per diem; by May that output will be 1000 tons, and the importation of coal from Newcastle is expected to cease. This will mean a loss of about 350,000 tons per annum to that coalfield. Having the State treasury to call upon, the mines are to be equipped with the latest machinery. This, of course, is good policy, as the only chance of competing on even terms with Newcastle is to use every labour-saving appliance. The State has offered the Government of South Australia a block of coal-bearing land alongside its mines for the use of the South Australian railways. Should the Victorian example prove satisfactory, that offer may be accepted and two large customers will withdraw from New South Wales.

Deep Leads.—In Victoria the failure of alluvial mining has again been discussed in connection with the Cathcart gold mine at Ararat. Shares in this mine went up to £6. 10s. and then fell rapidly to 12s. The mine is one that Bewick, Moreing & Co. took in hand when trying their prentice hands at alluvial mining and then threw back on the Victorian investors. What created the boom was the publication of a series of rich bulk-samples from the northern edge of the gutter. These ranged from 2 to 10 oz. per fathom and recalled the richness of the wash worked in the old days.

But the fact now comes out that this run of wash is narrow, at the most 200 ft., and that instead of there being £6. 10s. per share in the mine developed there certainly was not 20s., and probably not 10s. The heaviest losers are the men who backed the mine, not the public. Now the question arises whether the manager ought to have reported the rich samples and whether the board should have published them. In Australia we demand publicity in mining matters; if the manager had not told the results, he would have been condemned on all sides. Where the hiatus occurred was in not binding him down to specifying the width of the rich run of wash. It was a case of a disclosure of a part and not the whole of the truth. The facts are now out, for by pressure from the Press, the directors have called for a report of the quantity of wash proved. This is given at 3000 fathoms over a length of lead of about 1200 ft. by 200 ft. wide. Had the market known that this was all the wash that could be extracted at a profit, the share-quotation would never have been inflated.

A Storm at Broken Hill. Tailings in the air.

New Guinea. —The Government prospecting party sent out to Papua to test the country bordering German New Guinea has returned to Port Moresby with the news that they have discovered gold 60 miles up the Lakeamu river. They brought back three cocoa-tins full of gold. The river rises within 30 miles of German New Guinea territory and the country is exceedingly hilly. It is stated that payable gold was found for a length of 5 miles on a creek where 2 oz. per man should be easily obtained. Already miners are hastening to the district, which is fairly well accessible by launch. The natives are said to be wild and hostile.

The Bendigo Goldfield still keeps going, and despite the relative failure of the deep mines—down to 4000 ft.—to maintain their productiveness, the return for the past year has been satisfactory. Indeed the output of 212,034 oz. is the best since 1906 and there is a balance of dividends over calls of £59,000. A comparison of the results since 1901 is as follows:

Year	Gold Oz.	Calls £	Dividends £
1901	193,015	136,100	183,780
1902	192,822	131,631	207,990
1903	233,589	141,977	322,415
1904	248,785	168,094	367,896
1905	218,683	175,281	230,009
1906	223,733	221,262	246,254
1907	196,944	208,779	122,017
1908	193,253	135,923	126,268
1909	212,034	110,762	159,865

There were 20 Companies on the dividend list in 1909, headed by the Virginia, which is largely the property of the Lansell estate; its dividends amounted to £40,500. The next on the list were the veteran Suffolk United and the South New Moon, with £16,000 each. One of the features of mining in the district is the tributing system. This is under Government regulation, the conditions being so framed as to ensure the miner a living wage. The system has the advantage that it enables the companies to work ground that otherwise would be neglected, and also permits the directors to give shareholders a respite from call-paying. The gold won by tributers for the past year was 23,279 oz., and was the result of work carried on by parties of men in 40 different mines. The output from the Ballarat goldfield for the year was only 46,700 oz., and the dividend list was confined to five or six companies. This district has experienced great reverses of late. The big mines of the Sebastapol Plateau are exhausted and mining is now restricted to Ballarat East district; here there are possibilities for mining backed by adequate capital and if big tonnages are treated. But as the plan locally is to plug away on a small scale with the aid of the tributers, a change for the better is unlikely.

A fact of great mining importance to Bendigo is that the Victorian Quartz deep working may be stopped. The shaft was sunk to 4254 ft., then the company sank a centre-country winze, according to Bendigo practice, to explore for further saddle formations at depth. The winze was sunk 385 ft., or a total of 4639 ft., but no gold was found. The Government has been allowing the company £1 for each £1 contributed to defray the shaft-sinking, and at 4410 ft. specks of gold was seen in the ore, as was the case in the winze at a slightly greater depth. But these indications were not sufficiently favourable to induce the management to face the heavy cost of pumping with the primitive appliances available. The poverty of the returns from the deep formations and the limited extent of the orebodies indicate forcibly that it does not pay to mine below 4000 ft. There is a chance that the State may give further, as the Government Geologist wants to see sinking done to 5000 ft. The experiment is risky, but in mining one never can tell.

TIENTSIN.

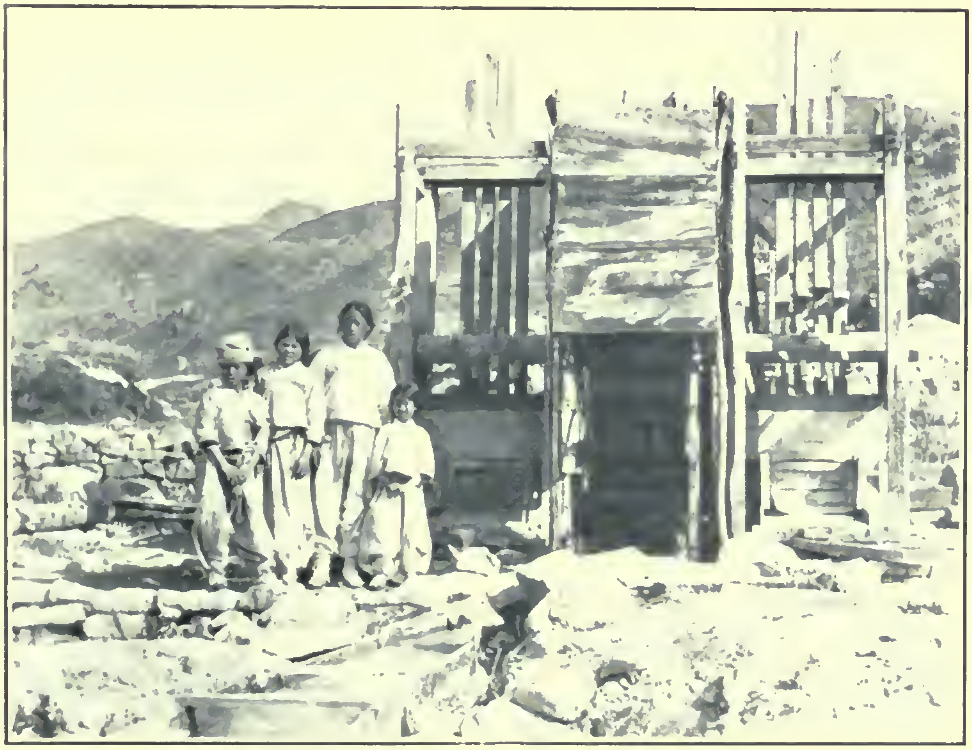
Coinage.—It is related of the unjust judge in the Bible that although he would not hear a matter because it was right, he finally gave way to importunity. Something similar seems to have been the case with the Chinese government in the matter of the Shantung gold mines. All work on them has been stopped for a great many years, and any attempt to develop them by foreigners or Chinese has met with that stubborn passive resistance so characteristic of the Orient. Lately German interests have been urgently requesting a concession giving them the right to develop the mines, and in order to end the matter the Board in question has given directions that the mines be re-opened under Government auspices; in fact, the Government has awakened to an interest in gold mining since there has been so much discussion of the advisability of establishing a gold standard in China. Duke Tse, the president of the Board of Finance, has been conducting investigations with a view to beginning a gold coinage; indeed, a newspaper report states that arrangements are to be made to import foreign coins. If there is any intelligent reason for doing the latter, it has not yet been disclosed. Coining gold would be equally futile unless the coinage is standardized. Not long ago assays were made on 20-cent pieces from different mints and they were proved to vary in fineness from 780 to 825 and to be about as irregular in weight. Even the coins from the same mint vary, some pieces consisting of blanks rolled so thin that after they are struck the impression is only half defined. It seems to be almost impossible to get the Chinese to do anything in a simple, direct and accurate way.

Shantung.—Restlessness has prevailed in Shantung in consequence of the mining privileges granted to the Germans. I understand that the Schantung Bergbau Gesellschaft has prospected the province pretty thoroughly without finding much except coal within the limits open to this company, and they have started two coal mines which together produced about 450,000 tons in 1909. Recently there was a report in a German paper that the rights of the German syndicate had been repurchased for 450,000 taels (about £90,000), but unless this means the rights exclusive of the present coal mines it can scarcely be true.

Shansi.—When the gentry of Shansi province bought out the rights of the Pekin Syndicate in that province a short while ago, they proceeded to form a company to operate the mines themselves. It is known as the Pao Chin Kung SSu (Protect China Company) and seems to have more patriotism than mining ability. At present they own a dozen mines that are in operation, and hold a great deal more ground that could be easily opened up. Most of the mines are provided with fair-sized shafts 150 to 300 ft. deep and have small geared hoists, with which a production of 50 tons per day per mine is maintained. In addition, one of the mines has a complete modern equipment, but practically no use is made of it at present, as there are no foreigners in the employ of the company, and the Chinese do not know how to use it, the company having carried its patriotism so far as to employ only Shansi people who know nothing beyond the native ways. I saw them sinking an 18-ft. shaft in limestone by methods that savoured of the days of Agricola. The real problem in working these mines is to get low enough freight-rates to Pekin and Tientsin, so that coal can be sold at a fairly low price and still yield a profit. At present, good bituminous coal sells for about 18 shillings per ton at these points and the Shansi anthracite for about 20s. If the freight-rates could be reduced so as to enable them to sell the anthracite cheaper than the bituminous, there ought to be a great market for it. The quantity of coal available in Shansi is something enormous; a careful estimate by Drake is 350 billions of tons of workable coal. Clearly the company has great opportunities before it, and it is regrettable that it is not living up to them.

Iron Ores.—A proposal was made recently to establish another government iron works similar to that at Han-yang at Tze-chou-fu, which is in the extreme southern part of Shansi, about on the south border of the anthracite field and not far from a smaller bituminous field. I have seen some samples of ore from the locality and it appeared of excellent quality. However, throughout northern Shansi the iron ore, though of fair quality, is widely scattered in small bodies, in thin beds that are pockety, making it extremely doubtful whether a large enough supply of sufficiently uniform quality could be obtained for a large blast-furnace plant. Of course, it is not possible to say that a proper supply would not be found by careful prospecting, but it would seem extremely desirable to undertake the prospecting first before starting a plant.

Chihli.—In line with the general desire to get the foreigner out of mining in China, the people of Chihli province are trying to get back the control of the Chinese Engineering & Mining Co., which produces about a million tons of coal annually at its mines north of Tientsin. It will be remembered that this was originally a Chinese company, but in the outbreak of 1900 the Chinese stockholders were easily persuaded to convert it into a foreign corporation in order to get it under foreign protection. When things quieted down they immediately wanted it back, but quickly found the getting it back was quite a different matter from giving it away. Ten years of litigation does not seem to have advanced matters and now the gentry of the province have appointed a sort of commission to take the matter up. The members of it are careful not to say what they intend to do; perhaps they do not know themselves. It is safe to hazard a guess that the negotiations will drag along until the mine has been almost worked out and then it will be sold to the Chinese at what would have been a fair price for it in the beginning.



PRIMITIVE WATER-WHEEL AND STAMP-MILL IN KOREA.

CAMBORNE.

East Pool & Agar.—The Committee's negotiations with an important financial group for providing the necessary capital for the development of these mines on an adequate scale, have, it is understood, fallen through, and they will now have to trust to their own resources. The loss at present cannot be far short of £1000 per month, and to reduce this as far as possible, a large number of the rock-drills have been stopped, pending some arrangement being made for securing fresh capital. The next call will have to be over £1 per share. A good lode, 18 in. wide, was recently cut in the bottom of East Pool engine-shaft, but the recent break in the main rod will prevent anything being done on it for some time to come.

Basset. These mines show a profit on the year's working of £87, as against a loss for 1908 of £4358. The quantity of black tin sold was 844 tons, as against 750 tons for the previous twelve months, the grade of the 42,587 tons crushed being 4 lb. higher, or an average of 44·4 lb. per ton. The development for the year was 1034 fathoms, but from the report it is evident that there is a poor zone of ground below the 260-fm. level, and the results have been disappointing. Marriott's shaft is now down two fathoms below the 310, where a station is being cut in readiness for a main cross-cut that is to cut the caunter-lode. If this lode, when intersected, is of equal value to the stopes under the 260-fm., then the perseverance of the shareholders may be rewarded. Pascoe's shaft is being sunk below the 300-fm. level on a much improved lode, valued by the manager at £40 per fathom.

Boswin.—The main shaft on this property, which is controlled by H. S. Gordon, is now 43 fm. from surface. The developments generally are satisfactory, and it is expected that sufficient ore will be blocked out in six months to call for the erection of a dressing-plant. The management here has not made the mistake, unfortunately not uncommon in Cornwall, of erecting a dressing-plant before it has been proved that there is sufficient ore available.

Wheal Kitty.—This company has recently purchased the 65 in. Cornish pumping-engine that has been standing on the Tindene mine for some years. This engine is to be fixed at Sara's shaft and will supersede the present temporary system of drainage, by which the water is pumped by a small horizontal engine, to a large cistern placed in the shaft, where it is automatically discharged into a travelling tank, raised to the adit, and there run off. Sara's shaft is now 530 ft. deep from surface, and it is anticipated that it must be sunk about 400 ft. deeper to intersect the Wheal Kitty and Pryor's lodes.

Condurrow United.—The report of this company for the past six months does not make cheerful reading, as the 205 fm. and 190 fm. levels eastward have both been driven all the time in poor ground. The manager strongly recommends that the mine should be drained to the bottom, and it is now proposed to reconstruct the company for the purpose of providing the necessary funds for this work. The money has been guaranteed.

West Kitty has now been taken over by the new limited company, which is being financed by the Falmouth Consolidated. Shareholders in the old company seem likely to have to face a heavy call to pay off the liabilities before they become entitled to their shares in the new company, in fact, probably not much less than 15s. per share. If this be the case, the deal for them has been a poor one. Locally it is thought unlikely that much new work will be undertaken here until the central power station of the St. Agnes Consolidated has been erected. This latter company holds properties all over the district—good, bad, and indifferent—and will need a large working capital if success is to be achieved. At any rate, no development work is being done at West Kitty.

Wheal Vor.—This mine seems to be pursued by misfortune, the recent accident to the engine being another set-back. The water has risen to the 112-fm. level again, and no doubt there will be difficulty in keeping it there.

Porthledden.—This property at St. Just is owned by Captain Frank Oats, and is managed by one of his sons. A 20-stamp mill has been at work for some time, crushing tin ore which is obtained from an old adit, and treating the dumps from the adjoining abandoned mines. Captain Frank is the owner of the land, and has built a mansion at Cape Cornwall; in order to beautify the place the refuse heaps from the abandoned mines had to be removed. The valueless portions were thrown over the cliff, and the remainder sent to the mill, which is hidden in a picturesque little cove.

Botallack Mine.—The manager, W. R. Thomas, resigned after being in charge for nearly two years, and J. W. Teale, of the firm of Bainbridge, Seymour, and Co., has been acting as manager, with T. Williams as resident manager. The Botallack shaft was unwatered to the 100-fm. level, but the water is now up to the 90-fm. level again and the centrifugal electric pump has got all it can do to keep the water from rising further. This has been an unusually wet season, and it is suspected that some of the surface water is percolating from the adit. Investigations are now being made to see if this is true. The drifts east and west at the 80 and 90 fm. levels are yielding a little ore, but the lode is small, not more than 2 ft. wide. Allen's shaft has been sunk 500 ft. The new 400-h.p. hoisting-engine is now working.

Levant Mine.—Last year 213½ tons of black tin was sold for £17,220, as against 186 tons the year before, which sold for £14,850, or an increase of £2,372. The improvements which should have been effected years ago are now completed and the results will show in increased output with diminished labour costs. The heavy rain at Christmas hindered operations. The coal bills are a serious item here.

NEW YORK.

Camp Bird.—There is much indignation among American shareholders of Camp Bird, Limited, at the Company's action in closing the books on January 6th. At the Company's extraordinary meeting, near the end of December, it was stated that shareholders would be given preferential 'rights' to subscribe £1 of new debentures for every £2 of old shares held and £1 of new ordinary shares for every £4 of old ordinary shares held. The Company "went through the motions" of sending application blanks to American shareholders. These blanks reached the persons to whom they were directed long after the books were closed. The Company might as well have thrown them into a waste-paper basket.

Guggenheim.—The annual report of the Guggenheim Exploration Co. shows that the corporation holds shares of Esperanza, inventoried at \$322,347 as against \$337,359 at the end of last year. Other holdings are Nevada Consolidated Copper \$4,234,408, Utah Copper \$4,788,647, Yukon Gold \$9,794,639, American Smelters Securities (A) \$13,860,000, bills and accounts collectable \$1,170,801. Cash and demand loans \$1,463,075. Other items bring the total assets up to \$36,857,064. The surplus is \$13,857,064. The Company owns \$11,249,000 American Smelter Securities common shares, which are carried on the books at a nominal value of \$1.

Goldfield.—The directors of the Goldfield Consolidated Mines Company held their regular quarterly meeting in New York this week and declared the regular dividend of 30 cents per share and an extra dividend of 20 c. This calls for a distribution of about \$1,800,000. A discovery of gold ore averaging \$100 per ton is reported as having been made at the 1000-ft. level.

The annual report of the Mines Company of America shows 110,200 tons of ore in reserve. The Company also has 30,000 tons of old tailing of good commercial value. The ore available is a little more than one year's supply.

B.C. Copper.—The annual report of the British Columbia Copper Co., just out, shows that during 1909 this company acquired 132,556 shares representing about 53% of the capital stock of the New Dominion Copper Co.: these shares were bought by issuing 88,709 shares of British Columbia from the treasury and paying \$11,593 in cash. The Company smelted 373,336 tons of ore during the year at a cost for copper of 9·82 cents per pound, including the cost of refining and marketing, after crediting, however, the gold and silver values in the ore. The operating disbursements for the year were \$985,216. The proceeds of metal shipments, including shipments unsettled for on November 30, were \$1,234,957. The Company's statement shows a balance of \$474,704, but \$364,018 of this was in copper on hand and in transit to refiners. The report seems to make it clear that no dividend is to be expected for the next few months, for the company has apparently not yet marketed its stored copper. The president says on the question of ore-supply, that the future of the company in this respect is now firmly established. A large additional tonnage has been acquired through the acquisition of the new Wellington claims.

Lake Superior.—The rise in the shares of the so-called new Lake coppers on the Boston market is comparable to the rise in rubber shares in London. Lake Copper rose in a few months from \$5 to \$90 per share. There were similar advances in North Lake, South Lake, and Indiana. These are the properties that are expected to fill the places of Calumet and Hecla, and the older copper mines of the Lake Superior region, as they become exhausted.

Anaconda.—For the first time the public is able to know the condition of the Anaconda Mining Co. The Company has just filed a report with the Stock Exchange and has been regularly listed. Amalgamated Copper is to be regularly listed also. Its report has been filed, but not yet published. The Anaconda report shows: sales of copper, gold, and silver for the six months ending June 30 last, \$6,060,028; and copper, gold, and silver on hand on that date \$5,931,690; copper being figured at cost. The profit for the six months was \$1,221,910. In the statement of assets, the mines, townsite property, and water rights are figured at \$30,443,350. The opinion is general that the Company has placed a low value upon its mines. The property at Butte covers 1168 acres and is operated through 11 shafts, ten of which are deeper than 2200 ft. During the last two years orebodies of excellent grade have been discovered in the lower levels, the existence of which was not indicated in the workings overhead. The president and chief technical adviser is B. B. Thayer. The Washoe smelter is operated by the Anaconda company under a lease expiring in 1912.

PERSONAL

A. W. Allen, who has been taking a holiday, is returning to Mexico.

R. A. Archbold is returning to Northern Nigeria.

L. S. Austin has opened an office in the Dooly Block, at Salt Lake City.

Sydney H. Ball sailed on the *Campania* on March 5, for New York.

T. H. V. Bower, recently in Brazil, is now in Chile.

Ernest H. Brandt has been admitted a partner of Bainbridge, Seymour & Co.

H. T. Burls is on his way to Peru.

Gelasio Caetani, who is consulting metallurgist to the Bunker Hill & Sullivan company, has opened an office at San Francisco.

Arthur O. Cautley and George B. Butterworth have gone to Madagascar.

Edwin E. Chase has been examining copper mines in Michigan.

G. Allen Crane is returning from Peru.

T. G. Davey is in Spain.

F. I. Leslie Ditmas has returned from India and is now at Fleet, in Hampshire.

G. S. Duncan is visiting copper smelters in the United States.

W. R. Faithful has gone to the Alexandrovski mine, Siberia.

John B. Farish is in Mexico.

J. W. Featherstonhaugh has been appointed manager of the Bell's Reef Mine, in Rhodesia.

W. R. Feldtmann is in West Africa.

Charles G. S. Gordon has left Matthew Francis & Co., of Halkyn, to take a post at Zacatecas, Mexico.

William T. Hall has resigned as general manager of the St. Ives Consolidated Mines.

W. S. Harrison, manager of the San Francisco del Oro company, will return to Mexico shortly.

A. B. W. Hodges, general manager for the Granby Consolidated, in British Columbia, is resigning this position to become general manager for the Cerro de Pasco Mining Co.

Alfred James left for New York, on his way to Mexico, on March 5.

C. B. Kingston is consulting engineer to the Rhodesia Gold Mining & Investment Co., recently incorporated.

N. B. Knox is returning from Burma.

H. H. Knox is expected in London from New York.

Benj. B. Lawrence, of New York, was recently in Cuba.

G. F. Laycock is on his way to Siberia to take charge of mines in the Altai.

W. J. Loring is at Mandalay, Burma.

E. A. Mannheim, general manager for the Brazilian Goldfields Ltd., is expected in London shortly.

Walter McDermott is on his way homeward from Johannesburg.

J. C. Nicholls, lately in Korea, is expected in London.

E. H. Nutter is in London.

Frederick M. Perkins, lately in Mexico, has gone to Peru.

A. Quartano, in the cyanide department of the Dos Estrellas company, is returning to El Oro, Mexico.

William Rich sailed for South Africa on February 27.

J. Henry Rickard is going with an exploring expedition to the Congo Free State.

Hallet R. Robins has been appointed manager of the Ironsides mine, near Boise, Idaho.

Hugh Rose has been appointed manager of the Santa Gertrudis mine, at Pachuca, Mexico.

G. H. Rotherham, lately at Tonopah, Nevada, has been appointed reduction manager for the French Bobs Mines in the Transvaal.

Clarence C. Semple is now resident at New York, with an office at 5 West 65th St.

S. J. Speak has returned from Argentina.

J. W. Teale is on his way to Canada.

Harold L. Twite left for Burma on February 25.

Walter H. Weed is examining copper mines in Michigan.

Stuart S. Webb-Bowen is at the Fanti Consolidated mine, at Tarkwa, West Africa.

Arthur Wilkinson has been in Colombia recently.

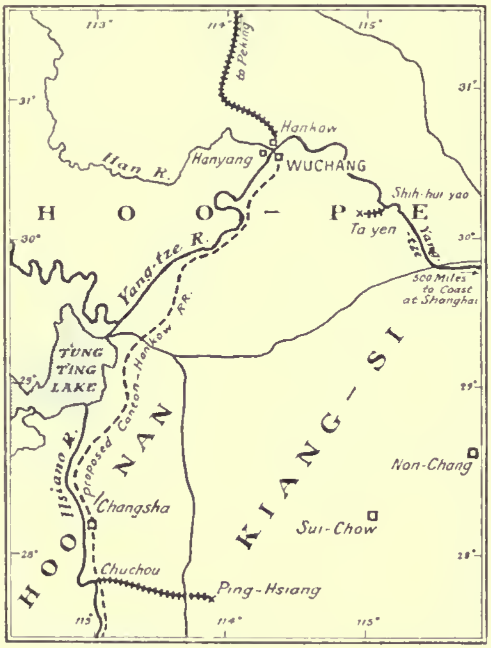
Elwood J. Wilson was at San Francisco in February.

Pope Yeatman is in Chile.

STEEL MAKING IN CHINA

By THOMAS T. READ

Introduction.—Though the coal and iron resources of the Chinese Empire have been known for many years to be extensive, their development has been restricted by the lack of transport facilities. Until railroads were built the traffic was necessarily water-borne. Excepting a few great highways constructed under Imperial auspices for military purposes, there is almost nothing worthy of the name of road. This should not be taken to indicate that there is little traffic carried on by land. I cannot understand why the Chinese, who are so fond of starting associations for all sorts of purposes, have never formed an organization with the object of improving their roads. In fairness it should be noted that roads in China do not belong to the public, but are the property of the adjoining landholders, who are free to plough them if they so desire, a privilege not infrequently exercised. Also the climatic conditions in a large part of the Empire are such that earth roads would be quagmires for a large part of the year, and the use of macadam is rare outside of the treaty-ports. Water transportation, despite its great cheapness, has the serious drawback that in the regions where minerals are abundant streams are generally lacking. Enough perhaps has been said to make it clear that no more than a limited development of the production of coal and iron ore was possible until the advent of the railroads. Under the old regime, except for a small amount of steel for knives, etc., made by case-hardening, the Chinese used only cast and wrought-iron, and these only to a limited extent. The largest pieces of wrought-iron made by native methods are the anchors for sea-going junks, and the most important use of cast-iron is in the manufacture of the hemispherical pans, about 18 in. diam., which are used for a variety of purposes, chiefly domestic. The supply of iron for these objects was drawn from a number of places throughout the Empire where coal and iron ore occur in convenient proximity. Of these places southeastern Shansi is the most widely known, and furnished the largest part of the total production. This is the region so frequently mentioned as exemplifying the great wealth of China in coal and iron. The ores are hematite and limonite of only fair quality, and occur as nodules in shale and sandstone of the Carboniferous system; rarely are masses of more than a few hundred pounds found. In some places boulders of ore are picked out of the stream-gravel. The ores contain 50% of iron, and are smelted in crude crucible furnaces; the yield from each crucible being 10 to 15 lb., or about one-half of the metallic content of the ore charged. These small billets are made into wrought-iron by heating and hammering, and are welded together to furnish larger pieces as desired. In spite of the apparent disadvan-



Part of China.

tage of so crude a method, skilled labour can be obtained for so low a price, from 4 to 8 pence per day, and the coal and iron ore occur so close together, that it is possible to produce iron at a low cost. The figures given by W. H. Shockley in a paper read before the American Institute in 1894, are 18s. 6d. per ton for cast-iron and 58s. per ton for wrought-iron, at the place of production. Mr. Shockley estimated that 50,000 tons of iron per annum were made in Shansi. Von Richthofen estimated in 1872 that 160,000 tons were produced annually. The latter figure may well have been correct at that time, as the industry has been steadily declining, because the smiths in the area adjacent to the treaty - ports soon found that foreign scrap - steel and scrap - iron are much better than the native products for a great variety of purposes. Thousands of tons of old horse-shoes, for example, are annually imported, to be worked into small objects.

The Shansi deposit is not likely to be an important factor in future iron production, as it is too low-grade and too irregular to be exploited by modern methods. There are, however, large and important deposits capable of exploitation that have not hitherto been touched, because they are not conveniently situated for working by native methods. One of these will be described later on. The extension of trade in China brought about new conditions. Steamships and railroads were necessary and these forced the opening of coal mines. Both made various forms of industrial enterprise possible, and all taken together created an unprecedented demand for iron and steel. The greatest demand was for fire-arms for the reorganized army. For a time these needs were met by the importation of finished products, but the efficiency and low cost of native labour soon led to the building of arsenals and iron works.

The next step was naturally to develop the production of the raw materials. Chang Chih-tung, that keen-witted and far-sighted statesman, early saw the necessity of developing an adequate source of supply of raw materials within the Empire, in the event of war. To the metallurgist the account of the building of the first steel works in China reads like a romance. In 1891, while viceroy at Canton, Chang Chih-tung ordered a steel plant from England. Before the machinery was delivered he had been appointed viceroy at Wuchang. The plant was accordingly transferred there and set up in a convenient place in the neighbouring town of Han-yang. The next problem was to find ore and coke for it. Fortunately ore and limestone of good quality and in large quantities, and conveniently placed for working, were found near at hand, but the problem of coke-supply was one of great difficulty. The cost of European and Japanese coke was prohibitive, and the native product was not of the right quality. However, from the interior of Hunan a small quantity was obtained and by proper treatment a coke of good quality could be produced. An expedition was therefore despatched to find the source of supply. The expedition ascended the Yang-tze to where the Hsiang river flows into it, and then followed the latter to a short distance above Hsiangtan, 375 miles from Hankow. From this point the coalfields extend south for a long distance, but it was necessary to find a mine as near the Yang-tze as possible, as the Hsiang is so shallow that navigation is seriously impeded during the larger part of the year. The place finally chosen was P'ing-hsiang, some 60 miles east of Hsiang-tan, just across the border of Hunan, in the neighbouring province of Kiangsi. The exploratory work was done by Gustave Leinung, now director of the colliery, and he deserves admiration for courage and persistence under trying circumstances. The Hunanese are noted for their hostility to foreigners, and it was necessary to carry on exploratory surveys with a guard of soldiers. Entirely alone, he carried out the work of mapping, prospecting, and exploration, often finding after a hard day's work that it was necessary to remain awake all night to repel an expected attack by the natives. Only those who have travelled in the interior of China, and have lived on Chinese food, and slept in Chinese houses, can have any conception of what it means to preserve an unbroken spirit under such circumstances.

The Coal Mines. — I shall first describe the coal mines and the method of producing coke for the steel-works. The total thickness of the coal measures is about 800 ft. There are eight workable seams, an upper group of two and a middle group of four seams of bituminous coal, and a lower group of two seams of anthracite. The bituminous contains 26 to 29% of volatile hydrocarbons and about 29% ash as it comes from the mines. To reduce the ash, the coal is washed before coking. The seams have been so shattered by earth movements that the coal breaks fine in mining, so that it is unnecessary to crush it before washing. One of the seams is firmer, yielding a fair percentage of lump-coal, which is hand-picked and shipped for fuel purposes. There are two washing-plants of similar design, and of a capacity of 500 tons per day each, but the one at the northern end is in process of being altered to a capacity of 1000 tons per day.

The coking is done in modern retort-ovens; there are six of these, or a total of 254 retorts in all. The retorts are 55 cm. wide on one side, and 65 cm. wide on the discharge side, to facilitate discharging them. Each retort is charged with 6 tons of coal, which is coked in 48 hours, the yield being about 4 tons of coke per retort, or 70%. It is found that the best results are obtained by charging with coal containing about 18% moisture. As soon as the anthracite seams are opened up it is planned to crush the anthracite and mix it with the bituminous, thus at once decreasing the amount of moisture required and increasing the yield of coke. The best quality of coke averages 11 to 13% ash, 0·4 to 0·5% sulphur, and less than 0·05% phosphorus. It has a good crushing strength and the quality is excellent. All the production of this quality is taken by the blast-furnace plant. A second grade is made from part of the slime coal. This is usually over 25% ash, and is sold in the market at Hankow.

A portion of the gases from the ovens is conducted to boilers to utilize the waste heat. At present there are not enough of these boilers to use all the heat, but before long a central electric plant of 3000-h.p. capacity, in course of erection, will take the rest of the gases. When this electric power is available most of the machinery will be driven by the current. At the time of writing electricity is only used for haulage in the main adit, and for lighting.

Most of the men employed work by contract. The conditions are satisfactory, and work proceeds smoothly. The foreign staff consists of Germans, of whom there are eight. There are probably about 4000 Chinese employed.

The Iron Mines. The iron ore is produced in the district known as Ta-yeh, about 50 miles southeast of Hankow. To reach this point it is most convenient to go on the Company's lighters to Shih-hui-yao, 80 miles down the Yang-tze. From here a standard-gauge railway extends 16 miles west to Tiehshan, where the ore was first opened, a short branch extending from near that place to Te-tao-wan, where most of the present output is obtained. The area in which the ore occurs is one of rolling hills with broad valleys between. The valleys are devoted to the cultivation of rice, and the hillsides are generally terraced for general crops. The region is one of great annual rainfall, which has a material influence on mining. The rock most commonly occurring throughout the area is limestone or marble, generally pure. The limestone is cut by a thick intrusive mass of grayish syenitic rock, the strike of the line of contact being approximately east and west, and the dip about 80° north on the south side. This contact was traced at the mine for about five miles, and, as seen from the train, it seems to persist over a much greater distance. There is little evidence upon which to determine the age of the rocks, but on lithological grounds the limestone would seem to be identical with the 'Sihia' (Hsi-hsieh) limestone of the Nanking system of Von Richthofen, which he says is probably Devonian. But as coal is associated, both at Von Richthofen's locality and at the one in question, there is some doubt whether it is older than Carboniferous. Judging from the remarks of the resident engineer, and from appearances, systematic prospecting would disclose orebodies at numerous places along both the southern and northern boundaries of the igneous mass, but there is little incentive

GENERAL VIEW OF PLANT AT HAN-YANG.

to this, as the ore exposed in the present workings is sufficient for present purposes.

The ore is opened up at two localities, Tieh-shan and Te-tae-wan, about two miles apart. At the latter the ore is a little more conveniently exposed for working, so production is centred there. The body of limonite is about 200 ft. thick and dips north steeply. The underlying limestone is faulted extensively, and there are cross-faults in several places. At Tieh-shan small bodies of limonite were found in the limestone at a short distance from the contact. At some places the line of separation between the ore and the syenite is sharply marked and at others the transition is gradual. At the eastern end of the orebody at Te-tae-wan the syenite forms both walls of the ore, the orebody becoming silicious and soon pinching out. The thickness is variable but would probably average 200 ft. On the side next the syenite there is usually a well-marked band containing sulphides, notably chalcopyrite. This is undoubtedly of later origin, and, outside of the band, does not appear to have affected the orebody, as the average sulphur content of the ore mined is less than 0·12%.

At Lung-tung the ore is strongly magnetic, and seems to have been partly converted into magnetite. During the Ming dynasty openings were made at this point, and some of the old slag still lies on the dumps. From the way in which the ground has been opened up it seems probable that these early workers were after the chalcopyrite, at this place especially abundant, but the working could scarcely have been profitable, as the amount of copper in even selected materials would be low. From here to the end of the railroad at Tieh-shan there is a large quantity of ore exposed, but not so high grade as that at Te-tae-wan. At the latter place the contact is crossed by a small stream that has formed a narrow steep-sided valley, called Ta-shih-men. On the east side the hill rises up to about 500 ft. above the valley floor, and on the west not quite so high ; the ore out-crops on the south side of the hills, near the top.

The ore is mined in open-cuts and is sent down to the main track on inclined cable-ways, of which there are three on the east and one on the west side. The stripping of the deposit preparatory to mining is done by coolies with baskets, who transport the earth to the edge of the bench and throw it over. As the deposit dips slightly into the hill the amount of over-burden to be removed increases with the depth. It might seem, at first sight, that some form of caving might be adopted with advantage, but the torrential rainfalls render any such method out of the question. Even at present it is necessary to suspend work during a part of the year, and to pay careful attention to drainage, lest the cable-ways be washed out.

The ore is rather hard in most places, and requires to be loosened by powder, and the large boulders block-holed. This is now done by hand-drilling, but as the native miner has no inclination to hit a drill hard enough to do good work, it is proposed to install a small compressor plant, and experiment with various types of air-hammer drills.

The ore-cars after being loaded are let down an inclined cable-way, trammed to the end of the railroad line, and dumped into 11-ton cars by a rotating hopper. The cost of handling and transportation is comparatively high owing to the crude methods. At Shih-hui-yao the cars are unloaded by hand and the ore thrown on the river-bank. The lighters moor near the shore, and coolies with baskets transfer the ore from the bank to the lighter. A similar method of unloading is followed upon arriving at Han-yang. A mechanical unloading system of modern type is projected, and will be constructed shortly. The lighters employed are of 400 to 500 tons capacity, but one of 800 tons is in use and more of this size are under construction. They are towed by light-draft tugs. The dolomite for the open-hearth furnaces is quarried near the river at Shih-hui-yao, and the limestone is quarried near Tieh-shan.

Besides furnishing ore for the company, the mines also supply a large quantity yearly to the Japanese Government works at Wakamatsu, but as these latter works employ the Bessemer process their specifications call for so low a content of phosphorus that it is troublesome to meet their demands.

The Steel Works.—The blast-furnace plant is at Han-yang. The value of this site is obvious. It is the business centre of the Chinese Empire, and is connected with Pekin by a railway and will soon be similarly connected with Canton. Ocean-going steamers ascend the Yang-tze to this point, so direct communication with the coast ports and indeed all parts of the world is available. It is not remarkable, then, that the officials of the company believe that this place is destined to become a great steel centre.

The plant and methods of work are so like those at any ordinary plant of similar capacity that it is scarcely necessary to describe them in much detail. Only two blast-furnaces are now in operation ; these are rather small ones of about 100 tons capacity each. Another furnace of 250 tons capacity is under construction, and a fourth is projected. The blowing-engines and other auxiliary apparatus are of the ordinary type, The pig iron from the blast-furnaces is tapped directly into ladles, and goes to Siemens-Martin open-hearth furnaces. The company possesses a 150-ton mixer, but apparently it has never yet been used. Three open-hearth furnaces of 30 tons each are in use, two more are under construction, and five more are projected. The furnaces are fired by gas, which is supplied by a set of Morgan producers of simple type. Most of the steel produced is converted into rails, fish-plates, and track-bolts, and the rolling mill is equipped accordingly, but there are also roll-trains for making plates and structural shapes. All the technical work is under competent supervision by trained foreigners, French in the steel works and rolling mill, and Germans for the blast-furnace and general direction. The steel produced is of good quality. The rails average 0·7% manganese and 0·35 to 0·4% carbon; a specimen that was tested in my presence showed a tensile strength of 77,000 pounds per square inch and an elongation of 18·5%. The Government has decreed that rails from this establishment shall be used in constructing railroads in China, so far as it is able to meet the demand. As there are now more than 1000 miles of railroad building in China and many more lines projected, the market for its products is assured. It is accordingly proposed to increase the capacity to 800 or 900 tons per day eventually. The company has been re-organized as a stock company, under the name of the Han-Yeh-Ping Iron & Coal Co., Ltd. To gain increased

Open-Cut at Te-tao-wan.

Coke Ovens at P'ing Hsiang.

Main Shaft at P'ing Hsiang.

capacity, new blast-furnaces are being erected, better facilities for the handling of material are to be provided, and the transportation of the raw products, especially on the Hsiang river, is to be improved. A gas-engine plant is to be installed at the blast-furnaces, and the surplus electric power thus derived is to be used for lighting the neighbouring city. An engineering works has been erected near-by for the construction of bridges, cars, switches, crossovers, etc. If the company develops as rapidly in the next five years as it has in the past five years it will become an extremely important factor in the industrial development of the country.

This rapid development seems to be due largely to the energy of the manager Mr. Li, who, though not a trained metallurgist, has added persevering effort to native ability and has made a conspicuous success of a project that had a struggle for existence during the earlier years of its life.

The total number of men employed by the company in all its properties is about 20,000. The amount of work done by an unskilled labourer is small, compared to that done by a European, but on the basis of total cost it is cheaper. Skilled workmen, mechanics, pattern-makers, etc., are effective when properly trained, and show an even more marked advantage over foreign labour in cost. The statement is often made that American manufacturers have little to fear from foreign competition, for, although the cost of labour is higher in America, its effectiveness is more than correspondingly greater. I am sure that this argument cannot apply in the case of China, for, judging from observation I am convinced that the result of efficiency divided by cost is greater for Chinese labour than for American. Pig iron from the Han-yang works has already been sold in the Atlantic and Pacific ports of the United States, and it seems unquestionable that the time will come when its furnished products will similarly be able to compete with those manufactured in the United States, Germany, and England.

Electric Zinc Smelting.—The French process for electrically smelting zinc ores, invented by E. F. Cote and P. R. Pierron, is described in United States patent No. 944,774 issued on December 28 last. There are two vertical electrodes and the feed is in the centre of the top of the furnace, between the two electrodes. The electrodes may be raised and lowered so that both may be above the molten ore, or one or both immersed in it, according to the effect required. There is a tap-hole in the bottom for the slag, and the plug that closes it is used as an additional electrode. The condensing-chamber is immediately adjoining the reduction-chamber, and most of its internal space is filled with a vertical cylinder made of refractory material and containing powdered carbon. This cylinder is kept at a high temperature by means of an electric current passed through it. In this way the volatilized zinc is prevented from becoming prematurely cooled, and thus the formation of zinc-dust is obviated. The vapour is condensed as liquid at the bottom of the chamber; thus one of the drawbacks of electric smelting of zinc ores is avoided.

Aluminium-Lead Alloys.—Hitherto it has been considered impossible to produce an alloy of lead and aluminium. British patent No. 1339 of 1909 granted to St. Laurent, Lancaster, McNeale, and Collins, all of London, describes a method of effecting the mixture of these metals. According to this process metallic aluminium is melted in a fire-clay crucible and allowed to solidify. A layer of litharge is placed upon it and then a covering layer of charcoal or graphite. The crucible is heated again and the mixture melted. Metallic lead is then added and the whole well stirred by means of a carbon rod. The lead reduced from the litharge and some of the added lead combine with the aluminium and, on pouring, a homogeneous and permanent alloy is obtained. A variation of the process consists of heating litharge or red lead in a crucible to a dull red heat; a mixture of metallic aluminium with a small quantity of lead croconate and carbonate is added; the contents are then raised to the temperature of fusion. In a second crucible some lead and alumina are heated until the lead melts, when a small portion of aluminium croconate is added. The contents of the two crucibles are then poured together and the mixture well stirred, and finally poured into moulds. It is found desirable that the crucibles and moulds should be coated with a mixture of charcoal, alumina, and litharge: otherwise the reactions are violent, and the charge may be ejected. The amount of lead added to the aluminium by this process may vary from 5 to 50%. These alloys are silver-white and homogeneous. They can be worked in a lathe and take a high polish, besides being malleable and ductile. They are said to be chemically inert and are not attacked by acids and alkalies nor do they tarnish on exposure to the atmosphere.

The New Potter Process.

The original flotation process invented by C. V. Potter in 1902 for the treatment of Broken Hill sulphides consisted of immersing the sulphides in hot sulphuric acid solution. Subsequently G. D. Delprat, manager of the Broken Hill Proprietary, modified this process by using acid sulphate of soda. These processes made use of the buoyancy of gaseous bubbles given off by the reaction of the acid on carbonates present in the ore. No mention was made of oil in the specifications, nor is it stated that any was actually used in the processes, though as exhaust-steam was used for heating the solution no doubt some oil was actually present. It is interesting to note, therefore, that Potter's Sulphide Ore Treatment Co., which was formed to consolidate the Potter and Delprat interests, has modified the processes by adopting the use of oil. The Australian patent 13,846 of 1909, which is officially announced as the basis of the business of the company, describes a process that differs from those connected hitherto with the names of Potter and Delprat. According to the specification, the ore is brought into contact with the oil before it is charged into the acid solution. The amount of oil used is given as ½ to 1% of the weight of the ore, and it is to be added to the ore either before, during, or after crushing, but in practice we understand that the oil is added to the ore when tipped into the bins. The agglomerating action of the oil takes place during crushing or during subsequent agitation of the pulp. The ground and oiled ore is then drained of surplus water and charged into a hot dilute acidulated solution contained in the spitzkasten, where the sulphides are floated by the gases generated from the contact of the acid with carbonates in the gangue. There are two points for consideration in connection with the process: As the oil and ore are mixed before coming in contact with the acid, it is presumed that, according to the inventors, the acid has no special function in helping the selective action of oil for sulphides, but that it is used solely for generating buoyant bubbles. It will be seen therefore that the metallic particles are agglomerated by oil before the ore is brought into contact with the acid. In this way the claim differs from that of the Elmore acid patent, in which it is specifically stated that the acid helps the selective action of oil for the sulphide. The other point to which we would draw attention is that the new process is not unlike that of the Minerals Separation company. According to the latter process, the ore is added to a hot dilute solution of sulphuric acid and afterward a small proportion of oleic acid is added and the mixture thoroughly incorporated by beaters. The two processes only differ in the sequence of the acid and oil. We believe that Potter was the first to suggest flotation in hot acid solutions, and we are informed that the Potter's Sulphide Ore Treatment Co. is bringing an action against the Sulphide Corporation, the users of the Minerals Separation process, for infringement on that score. But the introduction of oil by the Potter company would appear to modify considerably the situation in regard to the relative claims of the rival patents, and until further details are to hand we confine this notice to the description of the Potter process as at present conducted.

China Clay.

During recent years the courts have given decisions in several lawsuits relating to mineral rights and depending on the construction of the word 'mineral.' In our December issue we recorded a judgment of the House of Lords ruling that sandstone when it forms the subsoil is not a 'mineral,' and we entered into some details concerning the legal aspect of these cases. We have now before us the result of the appeal to the House of Lords in the china clay case in which the Great Western Railway argued that china clay was not a 'mineral,' but only a decomposed form of the granite subsoil. Lord Clifden is the owner of the mineral rights at the Carpalla properties in Cornwall which are leased to the Carpalla United China Clay Co. The open-cut workings gradually encroached on the railway and threatened to demolish it. Hence the lawsuit. The High Court and the Court of Appeal held that as china clay had always been worked under mineral leases and had always in practice been considered one of the minerals excepted under the Railway Clauses Consolidation Act of 1845, the judgment must be against the railway company. In the House of Lords the decision of the lower courts was unanimously upheld, and their lordships considered the case so simple that their judgment is quite a short one. They endorsed the views of the courts below, and added some further general remarks. While admitting that the china clay formed the subsoil, they considered that the rare occurrence and the special value of the material made the case quite distinct from the cases involving sandstone or brick-clay; there could therefore be no doubt as to the inclusion of china clay among the minerals covered by the Act.

DREDGING AT NEVIANSK

By CHESTER WELLS PURINGTON

THE Neviansk property is situated five days from London, in eastern Russia, five hours north of the city of Ekaterinburg, on the Trans-Siberian railway. It consists of 100,000 acres, of which about 3000 are covered by gold-bearing gravel suitable for dredging.

Thirty million roubles (£3,000,000) in alluvial gold has been produced by hand methods from the property since 1820; but the rich gravel that can be worked by these methods is entirely exhausted. In 1902, the owners, showing considerable enterprise, built a dredge of the New Zealand type, to work the gravel underlying Neviansk lake. This is a body of water about 7 miles long by 1 mile wide, skirted by the railway near the town of Neviansk. The first installation was followed by others, and now eight dredges are operating, four with 5-ft. and four with 7-ft. buckets. The average gross recovery has been slightly under twenty kopeks (five pence) per cubic yard, for 200 acres, which have been worked out. About 1,500,000 roubles (£150,000), or 7,500 roubles per acre, represents the gross recovery. The cost is said to have been over 17 kopeks per cubic yard, or 4¼d. worth of gold; as the recovery was 5d. the work does not appear to have been profitable.

A glance at the accompanying photographs indicates that these dredges are everything that a good dredge should *not* be. The entire dredge parts were cast and tooled on the premises, at the Company's foundry and shops.

(a) They are operated by steam, instead of electricity; this is excusable when surrounding conditions render it necessary. At Neviansk, where electric power can be easily installed and cheaply generated, such practice is inexcusable.

(b) Too many men are employed. From the Company's reports it appears that 10 men on an 8-hour shift are employed on each dredge. What they do is a mystery.

(c) Of the 8 dredges, 6 have wooden hulls, which are all more or less hogged or strained. The construction is weak and faulty.

(d) The gantries are too light, and of improper construction for resisting strains.

(e) The open-connected system of buckets reduces capacity. It is no longer installed in modern dredges.

(f) The shape of the buckets could not be worse for successful dredging. In the Company's reports it is stated that the material dug will not dump, and that two men on shift are occupied in barring the sticky gravel out of the buckets.

(g) The bottoms, hoods, lips, and pins of the buckets are too light, and I am informed that no manganese steel is used in the lips, bushings, tumbler-plates, or other wearing parts.

(h) The housing is clumsy, and inconvenient, rendering the dredge dark and dangerous for those employed upon it.

(i) There is no position for the winch-man on the upper deck, from which he may conveniently watch the digging operations.

(j) Stackers, used in some of the dredges, are of the old-fashioned pan type, with slow delivery. No rubber-belt stackers are used, so far as I know.

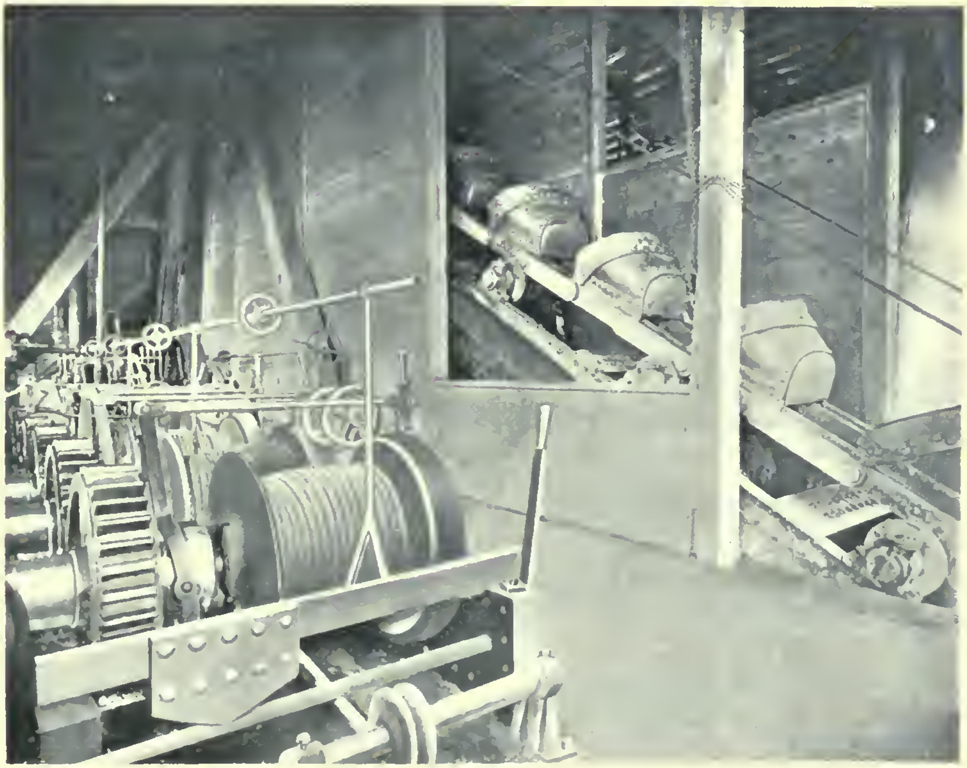
(k) Instead of hydraulic disintegration accomplished inside the trommel, as in California practice, an attempt is made to wash the gravel mechanically, which results in reduced capacity.

(l) The screens allow too much coarse material to go on the tables, resulting in a crowding of the same, and loss of gold.

The above are a few of the most glaring defects of these extraordinary machines. Notwithstanding their inefficiency, one of the 7-ft. boats treats nearly 50,000 cubic yards per month, and the average dredging season for several years past has exceeded 250 days, from March 15 to December each year. From these facts it appears that the material must present few difficulties of handling, and that winter conditions have been successfully overcome. Indeed, some valuable data concerning winter dredging at Neviansk have been accumulated and published by Barbotte de Marny, Assistant Chief of the Russian Imperial Department of Mines at St. Petersburg.

But if these poor apologies for gold dredges can handle from 900 to 1600 cu. yd. per day for 250 days per season in a Russian climate, it is unquestionable that (in view of recent

GOLD DREDGE IN NEVIANSK LAKE.



BUCKET-LADDER AND WINCH, NEVIANSK DREDGE.

experience with close-connected electric dredges in California, Montana and the Klondike) Neviansk dredging is susceptible of great improvement.

I have twice visited the Neviansk property, and more than twenty times have passed the Neviansk and adjacent lakes and dredging areas on the railway. No more nearly ideal physical conditions for gold-dredging exist than on this property. The giant electric dredges now operating at Folsom, California, in 15-ft. ground, and handling from 200,000 to 250,000 cu. yd. per month, would do as well, or better, at Neviansk, and on many of the rivers, lakes, bad lands, bogs, and flats of the Ural. Some that may be mentioned are the drainage areas of the rivers Isset, Lozva, Tura, Iss, Lobva, and Nyasma. All these rivers, with the bogs and flats adjacent to them, are laden with gold-bearing gravel containing recoverable values of from 5 to 15 cents per cubic yard. So far as climatic conditions go, I understand that dredging in the Klondike has been carried on without difficulty at a temperature of 20° below zero (Fahrenheit) last November. This 7-ft. boat made an average of 3558 cu. yd. per day, in gravel containing spots of permanent frost, the worst condition a dredge can encounter. This is more than double the capacity of the best dredge at Neviansk, where no permanent frost exists. Dredges are also successfully operated in Montana and Colorado at a temperature of 25°F below zero. No worse temperatures are faced in eastern Russia. It is rarely as cold as 30° below zero in the Ural region.

At Neviansk the amount of clay occurring with the gravel affords no obstacle to washing with the powerful high-pressure pumps in use on the California dredges. At Folsom, during my last visit in May 1909, No. 6, a 9-ft. boat was digging and washing gravel at the rate of 130,000 cu. yd. per month, harder and more difficult to wash than any gravel I have ever seen in the Ural. I have no hesitation in saying that a 7-ft. boat on average Ural ground should handle at least 1,000,000 cu. yd. per season. If it does not do this, it is either a bad dredge or is not properly handled.

The cost of dredging in the Ural should decrease in proportion as the yardage per dredge is increased, and as improvements in construction, quality of material used, centralization of power, reduction of labour, and lengthening of working season are effected. At present the Neviansk dredges are said to lose about 40% of possible running time. This is caused mainly by necessary repairs, owing to weak and faulty construction. Compare this with the record of the Canadian Klondike Co.'s dredge in 1909. This dredge is said by the manager to have lost only 368 hours in the entire season from May 9 to November 20, or less than 8%. It is further to be noted that this dredge is working in the Klondike river, in a locality remote from railways and large shops, while Neviansk is equipped with a foundry and shops within a stone's throw of the dredges.

The cost of labour, power, repairs, renewals, supplies, superintendence, and incidentals, items that constitute actual working cost, should be no higher at Neviansk than in California. Whereas the average working cost at Oroville, with boats of comparatively small capacity, is 5 cents per cubic yard, the Natoma No. 1, at Folsom, is said to be dredging for 2 cents and the 7-ft. boats at Hammonton on the Yuba are undoubtedly dredging for about 3 cents. Increase of capacity bears, although not a direct, still a noteworthy relation to reduction of cost per cubic yard. Second, the amortization of capital account, charged to yardage handled, bears, of course, direct relation to capacity. Third, the distribution of administration costs, over the number of cubic yards handled by Russian dredges, also becomes a directly decreasing burden as yardage increases. This last factor is the *bête-noir* not only of dredging but of all gold mining in Russia and Siberia. The subject is far too weighty and important to be discussed in this short paper, but a brief reference is necessary.

The Neviansk property contains 100,000 inhabitants—men, women, and children. Even allowing that the dredging industry requires the services of 200 men, and can legitimately support them and their families, it is evident that there are over 99,000 people on the property, whom the dredging industry will not support. As they are scattered in villages over the dredging areas, and other parts of the property, any attempt to evict these poor people would meet with serious opposition. On the other hand, if they remain there, their maintenance must be charged to administration expenses of the dredging company. Farming is poor, and agriculture forms a very small asset of the property.

The nearest comparison imaginable to the present Neviansk dredging industry can be made by supposing the gold dredges at Oroville, California, to be obliged to charge to administration expenses the support of the entire population of the Sacramento valley.

SINTERING OF COPPER ORES

By WALTER G. PERKINS

FOR several years metallurgists have awaited the successful introduction of an economic method of sintering fine copper-bearing material. 'Sintering' has revolutionized blast-furnace practice in lead smelting because the product thus obtained is so well suited to form a component of the blast-furnace charge, increasing the capacity of the furnace and eliminating both the hand-roaster and the inefficient briquetting machine. There has been much thought given and much money spent in trying to perfect a process and a machine with which to render this important development of smelting applicable to copper-smelting in the blast-furnace. Many metallurgists are at work on this problem. No one, however, will venture to say that this branch of the art of copper-smelting has as yet been carried to a success or placed on a basis that would not be considered as an experiment by a board of directors or firm of consulting engineers examining the plans for a proposed large plant.

Sintering has become almost a necessity in the treatment of the low-grade 'porphyry' ore in Utah and Nevada, where the percentage of copper is from $1\frac{1}{2}$ to $2\frac{1}{2}$% and the saving at the concentrator is from 60 to 70%. The saving in concentration and its relation to smelting, especially in the treatment of such low-grade ores, are more closely allied than is generally conceded, for every pound of copper that goes over the dump is a direct loss to the investor. In modern mining the concentrator or smelter, or both, belong to the mine, just as much as the hoisting plant or other surface equipment; all of them are appliances to recover the maximum extraction of the copper in the ore, with a view to a profitable business. In other words, the mine should own the smelter or the smelter own the mine, not as subsidiary institutions one to the other, but as parts of a unit, the different departments of which work together to a common end, namely, that the company, not the mine or the reduction plant, shall show a profit. The separation of the mine from the reduction plant, not by distance but by want of proper affiliation, is detrimental to the economical results of both the mining and metallurgical departments. Thus the manager of a large low-grade copper enterprise is called upon to be both a miner and a metallurgist, at least from an administrative standpoint, if not in detail; and the conditions thus created demand a combination of experience difficult to find in these days of specializing. There is a life's work for the miner, concentrator, or smelter-man each in his own sphere, if he does his work in a manner technically correct, not to say anything of the executive ability required to make him successful in any one department. This condition has only arisen in recent years because previously the mines were small and the ore high-grade; the miner dealt with the custom smelter, selling his ore outright as best he could. In lead mining the joint ownership of mine and smelter is not so essential as it is to the low-grade copper mines producing large tonnages. The Nevada Consolidated, Cumberland-Ely, and Steptoe Valley companies furnish the best illustration of this new phase of the industry.

In Nevada and Utah the principal plants are limited to McDougal-roasting and reverberatory-smelting because the maximum size of the concentrate is 2 millimetres, with a screen analysis showing 3% on an 80-mesh screen and 23% going through 200-mesh, and a chemical analysis of 35 to 40% silica and 19 to 22% sulphur. From these data it is obviously impossible to roast without the addition of extraneous fuel, in view of the fact that enough sulphur has to be left in the calcine to allow for 40% being volatilized in the reverberatory, leaving enough to make a matte of 47 to 50% copper, this being the best product for converting. Another consideration is that when the sulphur is as low as 19%, the iron is also low, and the silica correspondingly high. Even when limestone is added to a point where it makes the furnace show the effect of too much lime, the slag is still a refractory slag from a reverberatory-smelting point of view, for it contains from 45 to 50% silica.

It can be seen from these figures that smelting by roasting and reverberatory practice is close to its limit, both from a technical and economic standpoint. This fact holds the concentrator to a narrow margin of saving, lest the silica become excessive, and the iron and sulphur prove insufficient for the subsequent treatment. If the smelting department claims that a big tonnage and a large copper production cannot be maintained with a product of such refractory nature, the concentrating department replies that more silica must go into the concentrate if a better saving is to be made. The smelting department is just as much interested in saving the 30% of the mine-product for the investor as the concentrator-man or the directors themselves. This being the case it becomes an economic necessity to improve the smelting methods and the mill-man must be given an incentive to save the silicious product that goes over the dump, because the poor saving of fine silicious ore is largely controlled by the fact that such material cannot be subsequently treated; for two reasons, first, it is too refractory to treat by roasting and reverberatory, and second, it is too fine for direct smelting in a blast-furnace. Had it not been for the improvements in reverberatory smelting originally developed in the Washoe plant at Anaconda, and later installed at the Garfield and Steptoe plants, the treatment of the low-grade ores of Utah and Nevada would have remained a hopeless problem, for in these districts the mills yield large tonnages of fine concentrate, and only a few years ago metallurgists insisted that a fine concentrate must be briquetted and treated in a blast-furnace. The development of the McDougal roaster, an efficient and economical machine for calcining, and the increase in size of the reverberatory, together with the use of the waste heat after it has left the furnace for generating steam to the extent of 500 to 600 boiler horse-power per furnace per diem, has increased the ratio of calcine smelted per ton of fuel from 2 : 1 in the small reverberatory furnaces of ten years ago to $4\frac{1}{2}$ or even 5 : 1 in some cases, and a conservative average of $3\frac{1}{2}$ to 4 : 1 on a charge making a slag containing 40 to 42% SiO_2, and 5% Al_2O_3. It is easy to see the marked effect of the advance of reverberatory smelting upon the smelting of fine material, but even now there is a limitation to the use of reverberatory furnaces, as they will not work satisfactorily on charges as refractory as those successfully smelted by the blast-furnace. Copper metallurgists will agree that a charge making a slag of 48% SiO_2, 9% Al_2O_3, 20% FeO, and 20% CaO, would be impracticable in a reverberatory, but, with care, would be amenable in a blast-furnace, especially if it had the large matte-fall that results from smelting sintered concentrate. It is not probable that such a refractory slag would be obtained when treating a sintered concentrate, and I have only used this empirical slag to illustrate how a charge could be smelted in a water-jacketed blast-furnace that would eat the roof off a reverberatory furnace, especially over the bridge-wall, almost as fast as it could be replaced. It is well known what damage is done to a new reverberatory furnace when smelting in a silica bottom, melting off probably two or three inches of almost pure SiO_2 in the region of the bridge-wall in order to get the bottom smelted at the front of a 112 by 19 ft. reverberatory furnace. Another point must be kept in view: even in the ordinary smelting after the furnace has started its regular work of treating calcined contentrate, the limit has almost been reached when it is possible to keep a furnace running steadily for more than a few weeks without shutting down and replacing the roof over the front part of the fire-box, bridge-wall, and say 10 ft. along the hearth, because the high fusing point of the charge slows the furnace down, with the intense heat necessary to smelt a charge making a slag of 45 to 50% silica. In a reverberatory furnace two conditions have a marked effect: first, when the furnace is slowed down because of a refractory charge, it does not necessarily receive the same quantity of cold or comparatively cool calcine, as it does when running on an easy charge; and secondly, the furnace is not opened so frequently to test the bottom with a rabble, which admits cold air and helps to keep the roof cold. These two conditions combined tend to protect the roof when running on an easy charge of such an analysis as allows a furnace 112 by 19 ft. to smelt 375 to 400 tons on a coal ratio of $4\frac{1}{2}$ to 5 : 1. On the other hand, the furnace-men when working on a refractory charge will fettle every possible hole around the doors, cracks in the roof, and every other conceivable place in order to get as much tonnage through as possible, beside lowering the ratio of coal to calcine probably to $2\frac{1}{2}$: 1. Consequently, with the tremendous heat generated and the small amount of calcine smelted, the roof of the furnace melts with great rapidity. This fact has only become obvious since the large tonnage of silicious concentrate produced in Western America has become a big factor in the metallurgy of copper; it is a fact that has come under my own observation and indicates that the percentage of silica in concentrates must be kept within narrow limits, otherwise the difficulty arises of finding bricks that will stand the high temperature necessary to smelt a highly silicious concentrate. Such bricks are not obtainable at a reasonable cost, the only alternative being magnesite or chromite in some form. On the other hand, the silica content would make no difference from a mechanical standpoint in a blast-furnace and can be overcome with lime as a base to offset the excess silica up to about 30% CaO in the slag.

It is evident that improvements are demanded in smelting methods just as much as in water-concentration if we are to save some of the 30 to 40% of copper that goes over the dump even in the most modern of the large concentrating plants.

The success of sintering depends on the regulation of two factors: the fusing point, and the density of the charge. The first of these can be viewed from two aspects: (1.) Sintering the fine for subsequent pyritic smelting out of an ore carrying 30 to 33% sulphur, the object being to eliminate only the first atom of sulphur from the FeS_2, which atom is acknowledged to have no value in a furnace smelting pyritically, but may be used to agglomerate the fine ore and thereby make a product that is an ideal component of a charge intended for pyrite smelting. (2.) Sintering concentrate carrying as low as 15% sulphur, or, by experiment, to determine the point at which the heat generated by the burning of the sulphur will agglomerate the entire charge, still leaving enough to produce a matte suitable for converting. To bring this statement within narrow limits would be impossible; the analysis of the concentrate will decide; this could have a wide range, the copper varying between 7 and 30%, with just as wide differences in the silica, iron, and sulphur. For instance, when the copper is mostly chalcocite in a highly silicious gangue, the concentrate to be made would be rich in copper and highly silicious; in another case, the iron being largely magnetic the aim would be to make a concentrate low in copper and sulphur, but high in iron. Such abnormal conditions affect the density or fineness of the charge, and the fusing point. The success of sintering depends as much on the proper understanding of the screen as on the chemical analysis. The screen size may range between ⅜ in. and less than 200 mesh, each case being solved by careful study. The chemical analyses supply the data from which the fuel-content and subsequent fusing point are ascertained, and the screen analysis gives an indication whether air can be forced or induced through the charge, in order to regulate the air-pressure and the thickness of the ore-bed in the furnace.

Two types of sintering devices have been used successfully. The first is 'pot-roasting' and involves the treatment of a thick bed of material. The charge is ignited from the bottom and air is forced upward through the charge to carry on and complete the operation. The second type involves the treatment of a thin bed; this is 'layer-roasting.' The charge is ignited from the top and air under pressure is induced downward through the charge. Pot-roasting has many modifications; using various sized pots, blast-pressures, means of igniting the charge, etc., all having merit and showing the result of an earnest effort to get to the bottom of the trouble, but none has yet been able to overcome the difficulty of evenly sintering a charge of fine screen analysis or the expense of breaking up the material when the product has become a well sintered mass, such as is done in lead smelting. Even with this expense the new way is cheaper for the lead smelter than the old, but copper does not allow margins like lead. Thin layer-roasting looked at one time as though it would quickly consign pot-roasting into the background. When it does work it gives an ideal product; the expense of breaking up is avoided, but the density of the charge is a limiting factor. While it is comparatively easy to force air upward through a mass of material of any fineness, it is another matter to draw air downward through a similar mass, and when it comes to material the greater part of which will pass a 100-mesh screen, with a consequent proportion of even finer material, also carrying 10% moisture, it becomes impracticable to get air through the mass so as to convert it into fuel. The whole question resolves itself into the design of a machine that will overcome the difficulties both of the pot and thin-layer sintering schemes, and that will adapt itself to the varying conditions of density of charge as shown by the screen analysis of the material to be treated.

The economic problem resolves itself into the cost of roasting in MacDougal roasters with smelting in reverberatory furnaces as against sintering followed by smelting in blast-furnaces.

Undoubtedly the bulk of the world's future supply of copper will come from the finely disseminated low-grade porphyry deposits, of which at the present time 30% of the copper goes over the dump and is lost. Mill-men are working hard to save some of this copper, and they have already reached the stage where the smelter-men see the limit of economic treatment by preliminary roasting in MacDougal roasters (because of the low sulphur contents) and subsequent smelting in reverberatories (because of the highly silicious slag, nearly 50% SiO_2). The treatment of such ore creates mechanical difficulties in the furnace because the fusing point of the charge comes dangerously near the fusing point of the furnace itself, and the only solution seems to be the development of sintering in place of roasting, and blast-furnace smelting in place of reverberatory. A greater range of refractory slags can be smelted in a blast-furnace by the addition of limestone, because the difficulty of a high-fusing point is overcome by the use of water jackets.

No doubt many metallurgists will take exception to some of these statements, and their criticisms will be welcomed. I have purposely avoided mentioning the names of those who are working on this problem, as this article is not intended as a discussion of the merits of the various machines or of the patents covering them, but to lay before the profession a statement concerning current metallurgical progress in copper.

Smelting Copper-Tin Ores.—When ores containing copper and tin, such as the stannite ore at Oonah, Tasmania, are smelted in a blast-furnace, a bottom is produced consisting of copper and tin together with any gold, bismuth, silver, and antimony in the ore. The separation and recovery of the metals contained in these bottoms presents a metallurgical problem. In British patent No. 28,508 of 1908, C. H. Stewart, of the firm of Alexander Hill & Stewart, describes a method of treatment. The inventor has been in charge of the operations at Oonah, and his invention has direct reference to the problem presented in connection with the ores found at that mine. The inventor's proposition is to smelt these bottoms with sulphates of lime and soda. The sulphur thus supplied will form a matte with the copper, and the lime and soda will form stannates. Such part of the original bottoms as are not affected will form bottoms again and will contain all the gold, silver, bismuth, and antimony. If the original bottoms contain more copper than tin, silica may be added to combine with the bases in excess of the amount required to form stannate, or further supplies of sulphur in the form of iron pyrite or calcium sulphide may be added. If the proportion of tin is greater than that of the copper, some more base, such as lime, may be added. As an example of the process, a bottom containing 45% copper and 50% tin may be taken. The charge would consist of 2 cwt. bottoms, 5 cwt. sulphate of soda, 6 cwt. sulphate of lime, 6 cwt. carbonate of soda, 5 cwt. sand, and 35 lb. crushed coke. The product of smelting would be 8 cwt. copper matte containing 72% copper and 3% tin; 24 cwt. stannate slag containing 45% tin oxide, and 5 cwt. bottoms containing 49% copper, 22% tin, and the precious metals. The inventor, in a subsequent patent No. 28,509 of 1908, describes a method of treating the concentrated bottoms. He adds an oxide of lead and a sulphide, and smelts once more. The result is to produce a lead stannate which is removed in the slag, a matte containing the copper, and an alloy of lead and silver containing the gold, bismuth, and antimony.

Artificial Zinc Sulphide. — Zinc sulphide prepared by precipitation from acid solutions has been used as a white paint, but it has the disadvantage of turning yellow, owing presumably to the difficulty of complete dehydration. If it is heated above a certain point the dehydration is effected, but the substance has then a tendency to turn black, and in addition the heating has a bad effect on its covering power. According to British patent No. 23,645 of 1909 granted to J. C. A. Mayer and the Societe Chimique des Usines du Rhone, of Paris, the dehydration can be effected by first allowing the sulphide to remain in a dilute solution of sulphuric acid for a fortnight, and subsequently, after a thorough washing, heating it at a temperature of 80 C. for 24 to 36 hours. This treatment in acid alters the texture in such a way that the water may be easily removed and a perfectly anhydrous product obtained. This is said not to turn yellow or to blacken.

Rustless Iron. — Comparatively little wrought iron is used in America, mild steel being almost always employed instead. Users have been loud in their complaints about the inability of this steel to withstand the attacks of the weather. It is noteworthy, therefore, that recently a non-rusting iron has been introduced by the American Rolling Mill Co. at Middletown, Ohio. The carbon, manganese, and silicon contents are extremely low, being 0·05%, 0·01%, and 0·02% respectively. The ultimate tensile strength is from 47,000 to 49,000 lb., and its ductility is high. The resistance to corrosion is remarkable. Experiments with moisture and acids show that these have little effect. The steel is made in the basic open-hearth furnace and the oxidizing action is carried farther than usual. No ferro-manganese is used, but ferro-silicon is added to remove oxides. Aluminium is added in the ladle in order to remove occluded gases.

THE GREAT MINES OF THE RAND

By T. A. RICKARD

THE Rand can claim to have at least nine of the greatest gold mines, if it be understood that the measure of greatness in a mine includes both profitable production and the ability to produce profitably for a long period of time. We give statistics summarizing the performance of the leading properties in the Transvaal. These figures are impressive. Never has human industry been able to exhibit so intricate and complete a system of mineral exploitation culminating in so large an output of gold. Of the nine properties, three represent recent consolidations. The East Rand Proprietary includes the Angelo, New Comet, Driefontein, and Cason, now productive mines, as well as other properties to be developed later. The Randfontein South is a consolidation of mines in the Randfontein district, controlled by Sir J. B. Robinson, and includes the Porges, South, North, and Robinson members of the Randfontein group. The Crown Mines is an amalgamation controlled by Wernher, Beit & Co., and consists of the Crown Deep, Crown Reef, Langlaagte Deep, Robinson Central Deep, and Paarl Central mines, together with adjoining property.

For many years the Robinson mine held first place, but the East Rand Proprietary and the Crown Mines are now the leading properties on the Rand. In 1909 the 820 stamps of the East Rand Proprietary crushed 1,830,280 tons of ore for a yield of 635,906 oz., worth £2,703,155. The total profit was £1,259,653 on an ore yielding 29½ shillings per ton, at a cost of 15¾ shillings. The dividends for the year aggregated 40% on the capital and 7¼% on the market price of the mine as indicated by the share quotation on February 1, 1910. The ore developed is estimated at 6,584,768 tons, and there is enough undeveloped but known gold-bearing area to warrant an expectation of about 40 years life for this mine. These facts explain the high price of the shares, and the low interest deemed adequate. The East Rand Proprietary may fairly be termed an 'investment.'

The Crown Mines is a recent amalgamation of older mines. This amalgamation was effected only on July 1, 1909, so that the full benefit of the new policy has not yet been obtained. The figures in the table are compiled from the individual outputs of the four productive mines during the first half of the year and from the returns of the amalgamated company for the second half. The yield is 33·2 shillings as compared with 29½ shillings for the East Rand Proprietary, and the cost was 15·91 as compared with 15·75; but these comparative figures are not conclusive, because the East Rand Proprietary is in full working order while the Crown Mines has only recently started. In tonnage and yield the Crown Mines is nearly equal to the East Rand Proprietary; in profits, it ranks first.

The fourth largest producer is the Randfontein South. Here again the full benefit of consolidation has not yet been secured. The output of ore during the current year is expected to increase to 1,600,000 tons and the rate of dividend as given in the table fails to indicate the true condition. The 'probable life' is not specified because it is more difficult here than elsewhere on the Rand to make such an estimate, owing to the steeper dip of the 'banket.' We may add that in this article we refer solely to mines that are actually productive on a large scale, and we do not take into account the possibilities of ventures so important, but as yet incomplete, as the Randfontein Central and the two Modderfonteins.

It will be noted that the milling plants range from 120 to 820 stamps, but the addition of tube-mills is an important factor in augmenting the crushing capacity. It will be noted that the supplementary use of the tube-mill is general, and now constitutes a characteristic feature of Rand metallurgy. The Ferreira has the smallest number of stamps: this is an old outcrop mine, with an estimated life of only 4 years; hence the share-quotation represents a return of 19% per annum. This mine has for many years been considered an attractive investment and shareholders have provided their own amortization. The bonus recently paid is derived from accumulated profit and is considered as a return of capital. Transactions in the shares are infrequent and the market quotation is purely nominal.

Seven of these mines each produce gold to the value of about one million pounds sterling. The highest yield per ton is that of the Robinson, with 48·66 shillings or 12·16 dwt. per ton. A pennyweight of gold is roughly equivalent to one dollar. This mine is still the most

Name of Mine.	Mill Machinery.		Output, 1909.			Yield per ton. Shillings	Cost per ton. Shillings	Profit per ton Shillings
	Stamps.	Tube Mills.	Tons	Oz.	Value. £			
East Rand Proprietary	820	13	1,830,280	635,906	2,703,155	29·50	15·75	13·75
Randfontein South	400	13	1,121,224	372,536	1,578,553	27·92	18·66	9·26
Robinson	250	5	550,176	305,504	1,296,047	46·66	12·58	34·08
Robinson Deep	300	5	649,849	221,474	940,656	28·92	16·58	12·34
Simmer & Jack	300	6	814,072	266,702	1,132,870	27·50	14·42	13·08
Ferreira	120	3	339,250	162,925	691,979	40·42	15·50	24·92
Ferreira Deep	160	4	408,524	221,038	938,325	45·42	16·83	28·59
Village Main Reef	220	4	513,800	187,202	795,042	30·16	15·75	15·25
Crown Mines	675	15	1,570,397	618,992	2,607,321	33·21	15·91	17·30

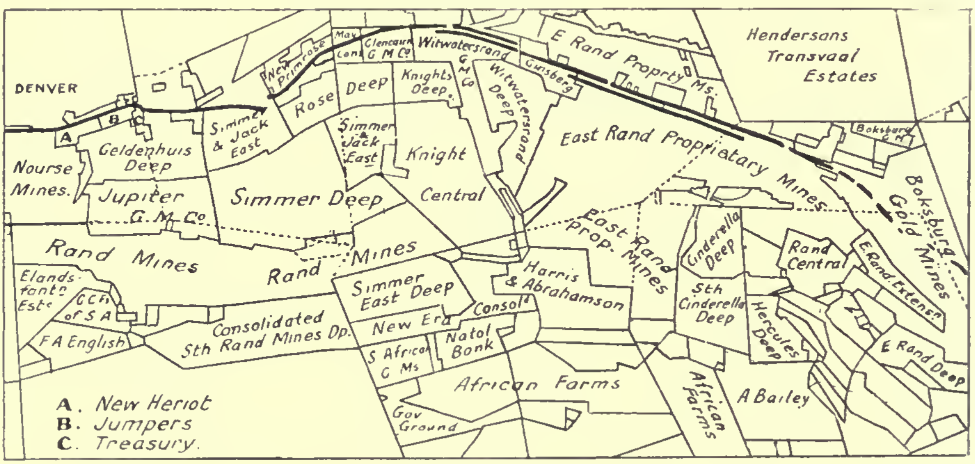
Capital. £	Number of claims.*	Profits. £	Rate of Dividend per annum %	Rate of Dividend at Market Valuation. %	Ore Developed. Tonnage	Dwt. per ton	Probable Life. Years.	Name of Mine
2,405,897	2896	1,259,653	40	$7\frac{1}{4}$	6,584,768 Dec. 31, '08.	7·2	30	East Rand Proprietary
2,000,000	1019	522,600	20	8	2,683,000 Sept. 30, '09	7·8	—	Randfontein, South
2,750,000	127	940,696	30	14	2,788,362 Dec. 31, '08.	11·3	8	Robinson
980,000	183	396,221	35	9	1,200,000 March 31, '09.	7·25	16	Robinson Deep
3,000,000	320	649,764	$17\frac{1}{2}$	9	2,500,000 June 30, '09.	6·5	12	Simmer & Jack
95,000	51	423,161	600†	19	1,317,565 Dec. 31, '08.	9·3	4	Ferreira
910,000	141	585,050	$52\frac{1}{2}$	$9\frac{1}{2}$	1,724,257 Sept. 30, '09.	9·6	14	Ferreira Deep
472,000	183	392,929	70	$15\frac{1}{2}$	2,831,727 Dec. 31, '08.	7	6	Village Main Reef
940,106	1970	1,357,869	130	$7\frac{3}{4}$	4,482,487 Dec. 31, '08.	7·94	50	Crown Mines

* Ore-bearing ground. 1 claim = $1\frac{1}{2}$ acres. † Including bonus of 300%.

profitable per ton of ore, for the cost is only $12\frac{1}{2}$ shillings and the profit 34 shillings, or $8\frac{1}{2}$ dwt. per ton. The figures for 1909 may be compared with those for 1906, for example, when the yield was 14·10 dwt., the cost 4·90 dwt., and the profit 9·2 dwt., indicating a decided reduction in cost, accompanied by a decline in the yield, together with a slightly less profit. This is the usual history of big mines, the decrease in cost warranting the breaking of poorer ore, thereby adding to the life of the mine while lessening the immediate profit. The lowest cost is credited to the Robinson, which has the highest yield; this is unusual and does honour to the management, for richness is generally accompanied by lack of thrift. The highest yield per ton is shown by the Ferreira Deep and the lowest by the Randfontein South, but the first of these produces only 408,524 tons per annum, while the other has an output of 1,121,224 tons in the same time. The Randfontein group always was low-grade and the development of this portion of the Main Reef series is the result of hard work and technical skill applied persistently for many long years.

The rate of dividend ranges from 10 to 600% on the capital, the amount of the latter being fixed in an arbitrary manner according to financial conditions obtaining at the time of flotation. Most of the shares have a par value of £1, but the Crown Mines is divided into shares of 10s. each, while the Robinson is a £5 share. It appears that the public deems 5% an adequate net return on the shares, allowing for re-investment of each annual instalment at 4%, together with an eventual return of the original capital. On this basis a net return of 5% would be paid by a mine having a life of 28 years and paying 7% in dividends per annum; or one paying 10% with a life of 15 years; or one paying 20% with a life of 6 years. These proportions are sufficiently analogous to the facts disclosed as to indicate sound business.

As regards 'ore developed'; this term applies to the ground actually blocked out and ready to be stoped. The 'probable life' is based upon the 'reef-bearing' area, that is, the extent of territory known to contain profitable ore, as ascertained by shafts and drill-holes on the mine itself or on adjacent mines. Thus there is a fixed limit to the operations, since the law does not allow the owner to follow the lode on its dip beyond the vertical projection of his boundaries. The mines of the Rand are assured of a continuity rare in vein-mining, but they lack the chances of those possibilities and eccentricities that play so great a part in gold mining elsewhere.



A PART OF THE WITWATERSRAND.

Metallurgical and Chemical Engineering.—This is the new title of our contemporary in New York, the *Electrochemical and Metallurgical Industry*, and it expresses the scope of the paper in a much more descriptive and euphonious form. The word 'engineering' shows that the subjects are treated from the point of view of industrial practice rather than from that of pure science. As a technical paper it is in the first rank, being under the direction of a man of high character and exceptional scientific attainment, Joseph W. Richards, of Lehigh University.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Alluvial Mining.

The Editor:

Sir—I noticed in your review of mining in the issue of December some data regarding the Lena Goldfields in Siberia; you stated that 604,000 cubic yards of gravel yielded £1,348,000, that is, the gravel yielded $10·70 per yard. This is fabulously rich ground: as a rule only the bedrock layer gives any such return.

Then I note that the net profit was only £400,000; therefore the cost must have been approximately $7·50 per cubic yard, which is absolutely unpardonable. You give no data as to the mine or methods of working, but I have had personal experience in a number of placer mines, and I do not recollect any such costs even in difficult headings, certainly never any such average costs for such a large yardage as 600,000 per annum.

Without knowing anything further of the case, but just basing my remarks on a broad experience in placer mining generally, I feel certain that there are a number of good men in California who would gladly take a $50,000 annual stipend and still save another cool half-million for dividends for the company. In regard to the same subject I noticed in the annual review issue of the *Mining and Scientific Press* some further data regarding placer mining in Siberia. It was stated that an American company was working over the tailing of a Siberian mine, with a Page bucket-scraper and saving an average of $1 per cubic yard!

A dollar per yard from placer tailing? Something is wrong in Siberia. When work slacks up a bit here I shall run over and see if some convenient tailing-dumps can be found to work on quarter shares.

JOHN M. NICOL.

City of Mexico, January 12.

[The high costs are due to administrative anomalies inherent to mining in Russia. In the Lena region the miners are allowed to secrete nuggets, which they then sell to the company at a reduced rate. The manager receives a commission on the value of gold produced, not the profit earned. A long winter season entails a big bank overdraft. The gentleman from California would not be permitted to take charge, even if he were appointed from London and armed with certificates of unlimited experience in placer-mining. The Russian idea is that other people besides shareholders are entitled to participate in the profits of mining, and it is not surprising therefore that preference is given to the natives, especially the worthy citizens living in the vicinity of a rich gold mine and the officials of an imperial bureaucracy. Our correspondent is a bit 'previous.' To operate in Russia not only is a knowledge of mining requisite, but also a sense of humour. — EDITOR.]

Dredging for Gold.

The Editor:

Sir—In your issue of January you have an editorial criticizing an article on gold dredging written by me in the *Mining Journal* of November 29, 1909.

You suggest that "incorrect inferences may be drawn with regard to dredging in California" and at the same time you make other statements which I must take exception to. You say I am engaged in the building of dredges, from which it might be understood that I was actually a dredge-builder, whereas I and the other members of my firm are consulting engineers and dredge-designers, and having designed more gold dredges than are at work in the United States, can claim to have some knowledge of the subject.

The commentator referred to in your editorial did not attack my figures, as you suggest; he merely re-arranged them for purposes of comparison, made a few comments, and asked some questions, all of which were answered in the *Mining Journal* of December 4. You say "if any comparison be more useless than another, it is the cost of dredging in regions far apart. In the very same district the character of the ground may differ, so as to make comparisons futile." By this argument, no comparisons of dredging would be of any value whatever, as the ground might be said to differ, but when you see quite a number of dredges of one type running with very high yardage costs, even in different countries far apart, and a large number of dredges of another type, running on much lower yardage costs, there must be some good reason for it, apart from the varying conditions or different character of the ground. There are at present between 80 and 100 successful dredges running in New Zealand, and I doubt if any of their yardage costs are nearly as high as those of most of the Californian dredges; certainly a large proportion of them are very much lower, as the gravel in many instances in New Zealand does not contain so much actual gold per yard as the working expenses of the Oroville company's most up-to-date dredges, and yet most of these New Zealand machines have been paying regular dividends. I give one instance of a dredging company, the Charlton Creek, in which I am a shareholder. The ground is so poor that the weekly returns have averaged not over 18oz. per week for the last nine years, or a yardage value of under 2·5 cents; and in spite of these very low values, the company has considerably more than returned its capital in regular and steady dividends.

The fact that the periods for which the figures given in my article are not contemporary should be all in favour of the American machine, for I presume that the later built machines should be of improved design. You say that "the aim of the designer is neither to make yardage records or minimum working costs, but the best economical results," or in other words, the largest return on the capital invested. With this I quite agree, but which is the better investment, a machine with 7 ft. close-connected buckets costing about £30,000, such as one of the latest Oroville dredges, which has treated 935,332 cu. yd. for the year at a cost of 5·58 cents, or a 7 ft. open-connected bucket, costing half the money, like those in Burma, treating 765,654 cu. yd. per year at a cost of 3·5 cents per yard? Assume the ground to be of equal value of 8 cents, as in Burma, and the Burma dredge will show a profit of £7118 or 47·4%, while the American machine will show a profit of £4251 or 14·17% on the capital cost of the machine.

It appears to me from all the claims for the American dredges that record yardage is their chief aim, which they have no doubt attained at the expense of both minimum working costs and economic results. This is certainly the case with the Oroville dredges as shown by that company's reports. I did not attempt to criticize others, not having their reports.

Your figures for the two large dredges, Folsom No. 4 and Natoma No. 1, are very interesting, and are the first figures I have seen quoted for these large machines, but it must be remembered that the Folsom No. 4 is working in extremely easy ground, not over 28 ft. deep, nor tightly packed, hence the low wear and tear on the buckets, and I have no doubt that if an up-to-date English type dredge with 13 ft. buckets was put upon the same claim, it would show equally low, if not lower, yardage costs. No. 4 Folsom is also working on a head-line, which contributes largely to the low proportion of power used to dig, and to the saving of bucket-wear. When visiting that dredge shortly after it started, I was told by one of the officers of the Company that the power used on No. 4 was less than that used on some of the dredges with smaller buckets, no doubt partly due to easier and shallower ground but mainly to the use of the head-line.

Is not the Natoma No. 1 dredge also working on a head-line and in easy ground? The very high yardage would almost point to this.

In answer to your statement that errors are made by me in reference to Folsom dredges, I can only reply that my information was given me by the officers of the Company and I have no reason to doubt it.

Referring to the open-connected type of bucket, you say "it is now deemed no more up-to-date in California than in the place of its origin." May I mention that it is still considered up-to-date in the place of its origin as well as in many other places. It is still in universal use in New Zealand, where it is used on more dividend-paying dredges than there are in the United States. Many of the dredging claims in New Zealand are much too rough or bouldery to use the close-connected bucket, and on the claims with small stones, where the close buckets might be used, it is considered that the extra cost of buckets, wear and tear to tumblers and pins, and the extra power required to drive them, will not be recompensed by the increased amount of gravel lifted.

I fail to see the reasoning why my figures taken from the Oroville company's reports should be "vitiated by the assumption that 12 dredges were in service during 1907-'8, while the fact is that only 9 were at work on an average during the year." Is it not patent to anyone that all dredges have a lot of lost time, due to stoppages for repairs, and a single dredge run by a company will have the same relative proportion of stoppages under similar conditions? Of the three dredges mentioned as not running, one ran for 9 months, one for 6, and the other for two months during the season 1907-'8. Even if you leave out the three dredges which shut down during the year, the average cost for the other nine is little reduced and is still nearly double that of the Burma dredges. Again, if you leave out the Bear River No. 2 dredge, on account of its excessive repair costs, you will still have an average cost of over 6 cents for the other 8 dredges. I have not seen the Oroville company's latest report for the year 1908-'9, but I understand the yardage costs have shown an increase of about 2 cents over those of the year before. In the face of this it can hardly be claimed that my figures are vitiated by assuming that these three dredges were in service.

You refer to the ideal conditions of working on a long head line of over a mile in length in Burma. I should like to know where the ideal conditions come in ? No dredge-master would work with such a long head-line if it could be avoided. The immense width of the Irriwadi river makes it impossible to work on a short head-line, except when dredging near the bank on the long side of a bend in the river. The elasticity of the long head-line causes the dredge to ram the face and increases the wear on the buckets, pins, and lower tumblers very considerably. The width of the river, the rapidity of the current, and absence of roads along the banks, makes it necessary to keep a large steam-launch and its attendant crew for each dredge, to supply it with fuel and stores, and to convey the dredge-crews on board and ashore at change of shift. In addition to this, the country being semi-tropical, it is necessary to have understudies for nearly all the men holding responsible positions. Freights to the claim are high, and, finally, there is a certain amount of compulsory stoppage through high river, which is usually taken advantage of for repairs. So much for the ideal conditions said to prevail. "Wash is mentioned, suggesting loose gravel." I am sorry to be misunderstood in this. In New Zealand all pay-dirt is usually referred to as wash-dirt, no matter from what depth or how hard it is.

I do not know what the gravel is like below Myitkyina on the Irriwadi, but 30 miles above and where the dredges are working, it is neither small nor easily dredged, as the bucking and surging of the dredges will show.

Again you say : "Our information indicates that these machines are hardly worth being copied," but it is a curious fact that these three machines in Burma have shown an average yardage cost of 3·5 cents as against the Oroville 12 dredges with costs of 6·72 c. per yard, and have beaten the Oroville company's record machine, which, according to Mr. Hammon's reports, is working under truly ideal conditions, namely, easy ground loosely packed and cheap electrical power, accessibility, and cheap freights on stores and duplicates. In addition to this, there is no lost time due to high river, shifting of crews, or handling of fuel with launches such as exists at Myitkyina.

INTERIOR OF DREDGE. GOLD-SAVING APPARATUS ON FOLSOM NO. 6.

You refer to the Golden Bed dredge, illustrated in my article, as working under ideal conditions, and say that this dredge would be ill-adapted for service at Oroville. The Golden Bed dredge was illustrated on account of the height to which it was stacking its tailing, namely, 50 ft. above water-level. This is, I believe, a greater height than any dredge in California is stacking its tailing, and it is capable of and has stacked its tailing to 60 ft. although the distortion of the photograph would make it appear to be stacking to its limit.

In my article this dredge is stated to be working in a high face of easy ground, hence the low costs and large output, but probably the ground is not so easy as you would imagine from the photograph. There is an overburden of about 30 ft. of fine river drift, then alternate layers of pay-dirt and drift, and 6 ft. of good hard tight gravel on the bottom with some fair sized stones in it, quite as large as the average stones I saw in the Oroville or Californian districts. This dredge is fitted with a silt-elevator which lifts and delivers the fine stuff into the main stacker, and the immense body of fine and drift runs down the face of the tailing pile covering all the stones, and thus gives a false impression as to the character of the gravel lifted.

From what I saw at Oroville and from Mr. Hammon's reports, I should judge that the gravel being worked by the Exploration No. 2 was fully as easily worked as that by the Golden Bed; in fact, her very high yardage would go far to prove this. A large body of drift does not necessarily make the ground easier to work, although it runs to the buckets and increases the output; it also chokes the tables and interferes with the gold-saving and silts up the stern of the dredge. The Golden Bed dredge happens to be a very strongly constructed machine as borne out by the low repair cost after eight years of work, and I quite disagree with your opinion that it would be ill-adapted for service at Oroville. With fuel at a reasonable price, it would work the Exploration No. 2 claim with much more economical results than the dredge at present on it. The silt elevator would not be required and with a shorter main stacker the wear and tear and expenses would be still lower.

The fact that "an experienced English operator has recently gone to California, where he placed an order for a dredge to be used in Burma " proves nothing except lack of experience in this matter, and he will probably gain that experience before his dredge has been working for twelve months. The shareholders may also have some experience. You say : " From this gentleman we learn that the Burma gravel is loose, affording easy digging, the dredges in use have buckets, the shape of which, together with the absence of a cutting edge on the lips at the side of the bucket, render them unsuitable for operation with a spud, hence the employment of the head-line." This statement, if correctly quoted, clearly shows that the person who made it knows little or nothing of the subject of dredging. If he refers to the gravel being lifted by the Burma dredges, he could only have seen it in the buckets, or after it had been dredged from the face, when there would be nothing to indicate its hardness or cemented nature. If he refers to the gravel in the banks above water-level, it is certainly loose, small, and carries very little gold. Again, if he refers to gravel lower down the river below the Burma Company's claim, which extends for 120 miles, it is well known that the gravel gets smaller and looser, while below Mandalay there is little or no gravel at all, chiefly sand or mud.

The assertion that the buckets have no cutting edges at the sides is absolutely absurd, and could only have been made by someone who had never seen the bucket. The use of the spud on the Burma dredges was never contemplated, as it would be quite unsuitable.

You say "Moreover, the joining of the buckets by open loose links hinders the efficient digging." This is a most extraordinary statement and one I should like to hear explained. From my own observations and from the published statements and figures of the California State Mining Bureau, it would appear that it is the close-connected bucket that interferes with efficient digging, or filling, except in very loose gravel. In a book called 'Gold Dredging in California,' issued by the Mining Bureau there is a table showing the comparative results of the working of two types, the one a close-connected 5 ft. bucket with spuds, the other a 5 ft. open-connected bucket and head-line. The gravel was similar and of the same depth in each case. The figures given show that the open bucket turned over 9% more gravel, while the power used by the close bucket was 50% more, its operating costs were 24% more, and its lost time 8·8% more than the dredge with the open bucket. In this case comment is unnecessary. But I should like to know if you can give me the name of any American type of dredge working outside the American continent that is paying its way. To my knowledge, they have failed in Siberia, West Africa, and in Tierra del Fuego, whilst in all these places the British dredges have been a success, but, of course, varying conditions may again be said to come in.

Your objection to estimates in running water does not hold good in regard to New Zealand, where most of the dredges are working in paddocks or flats as at Oroville, and my figures for these were taken from actual survey measurements of ground worked.

There is no necessity for elaborate systems of book-keeping to arrive at working costs of these dredges; the whole of the expenses of every kind for the year are charged, and this sum divided by the yardage will give the cost per yard lifted, while the difference between the total expenses and the value of gold won represents the profit. In most cases in New Zealand this profit is all paid in dividends.

W. H. CUTTEN.

London, February 9.

Tanganyika Concessions.

The Editor:

SIR—It is not exactly as a willing witness that I ask attention to the article in your January number on 'Tanganyika Concessions' as an illustration of how a technical journal may be mistaken when it seeks to narrow the affairs of a great corporation down to a technical point. I am the more tempted to do this for the reason that in the same issue prominence is given to the danger an engineer runs in becoming involved with the business of a company.

I hold no brief for Tanganyika Concessions, am not interested in its securities, and have no information beyond that published as to the proposed methods of treating the copper ores, but I do know something of its history. Tanganyika Concessions started as an exploring company and the success it has met with in finding great mineral belts can challenge comparison with any discoveries since the days of the Conquistadores. Further, it opened these belts so satisfactorily as not only to convince the Katanga Special Committee that they were workable but also to secure titles for the Union Minière du Haut Katanga on the very lines of its fondest hopes. This was the first great step accomplished in its career. These mines were so deeply hidden in Africa that even the pernicious combination of malarial fever, black-water, tsetse fly, and sleeping sickness was but a minor obstacle to development. Negotiations to secure the right of way had to be completed with three European governments and then the railroad finance had to be arranged in the face of recognized technical and other peculiar pessimism. One railroad is well across the Congo border and two others are headed for Katanga; and so the second step of the company has been successful.

It is now at the third step, namely, the profitable production of metals, especially copper, on a commercial scale and it is upon these attempts at a beginning that you have commented. It is probable that no one will admit more readily than the people most interested that large sums of money have been spent upon what has been accomplished, and some of this money could have been saved were conditions as well known then as now. This is in line with what has happened the world over; other large sums may be spent, squandered if you will, at this third step of development, but with what result? It is professional egotism to assume that a higher, because a different, order of talent is required to extract copper from Katanga ores than was needed to find those ores, make their existence known, and provide the transport, or that mistakes in the process will be of greater danger to the enterprise than were those admitted in other directions, while fairness seems to demand that men who have already surmounted enormous difficulties should be given credit for sufficient ability to take other bunkers as they reach them. If what you fear should really come to pass, if in fact not only two-thirds but all of the treatment scheme proposed should prove an unmitigated failure, still Katanga with its ores will exist; the railroads, the camps, the food-stations, the general opening up of the country would not cease to be a fact. Everything of intrinsic value represented by the £7,000,000 you say is at stake, would remain. The worst that could result would be that the ownership of a few of the securities held by the minority interest in the Union Minière might change; some fond hopes be blighted, some nerves shaken, and some men gain experience—quite inconvenient things doubtless for a few individuals, but only another regrettable incident for the enterprise.

Some years ago, as engineer, I formulated what I still think the best possible plan for handling the Katanga ores and devised a safe and sane method of gradually working up to it, but it required no extraordinary acumen to discover, without being told, that the "best possible plan" was not then, or is it yet, at all possible and the "safe and sane method" was applicable only to conditions not then existing; but I believe it will come about one of these days. For a technical man, "even the most experienced copper metallurgist alive," to get results he must eat, sleep, have proper appliances, intelligent and loyal assistance, and with a railroad such necessities will soon for the first time be decently procurable at Katanga.

The world is not now hungry for a large supply of new copper, and by the time that is wanted it will be known that it can be had from Katanga, and processes in due course will certainly be worked out to secure it cheaply. Meantime the Tanganyika balance-sheet has run up to a total that represents a heavy load for somebody to carry, but the shareholders can have the satisfaction of knowing that back of the figures is more of value than is represented in the beautiful certificates voted into existence in various 'copper mergers.'

J. R. FARRELL.

San Francisco, February 3.

Counsels of Imperfection.

The Editor:

Sir—In his letter of December 20 Mr. H. C. Hoover seems to have allowed a generous impulse for fair play to carry him into an illogical position, and if I appear to presume too much in picking to pieces the utterance of an authority so generally recognized, let the gravity of the issue be my excuse.

Mr. Hoover himself gives away the whole argument in his "sufficient answer" to your able indictment. He gives the real excuse for the claim advanced in so many words, namely, that an engineer should not be debarred from investment in the one business he knows something about. That is the point: self-interest, the seeking of profit; and yet he says that "there can be no objection to his [the engineer's] participation in promoting transactions when, *in appearance*, such participation does not affect his conduct." What could *appear* to influence a man's conduct more than the possibility of profit to himself? Surely this is the sufficient answer. Do not let us allow the issue to be confused by dragging in references to directors and financiers and organizers. It is with the promoter or commission agent that we are dealing—the man who undertakes for a consideration to do something, to raise money—and all this argument is presumably to justify the engineer in acquiring the gentle art of playing the game of bluff.

The statement that 90% of the evils of the industry arise out of ignorance may be accurate. The author of the statement has a reputation for statistics, but I suggest that 90% is due to the chicanery of the promoter, who generally knows quite as much as is good for him. Alas for human nature! I fear there is no lack of inclination to acquire the enthusiasm that Mr. Hoover speaks of; it is the inalienable feature of the position, and by putting the engineer into that position, it is not altered, but he is subjected to the temptations that ensue.

Does Mr. Hoover really think that a promoter offering a mine upon his own judgment and responsibility, is in a better position to benefit mankind than he who refers to the opinion of a disinterested engineer? Surely not, and if not, why should an engineer sacrifice his unassailable position to enter a class governed by conditions which admittedly foster the growth of parasites?

Mr. Hoover's definition of Mr. Hammond's 'mining man' is "a shareholder, manager, metallurgist, surveyor, the highly skilled, the honest operator and the captain of industry." This definition evidently includes the promoter, director, and financier class, which is admitted, as a class, to be infested by parasites; consequently when Mr. Hoover advocates the merging of the engineer as a class into the 'mining man' as a class, he is recommending that these parasite-growing facilities should be acquired by the profession, and so the words in italics should stand. Do not let us deceive ourselves; the subject is too important to be lightly dismissed. I have carefully re-read Mr. Hoover's last chapter on the duties of a mining engineer in his 'Principles of Mining,' and I cannot find any word to justify the crossing of this rubicon.

I suppose a doctor may be commercial enough to sell drugs, but should a hospital surgeon make a practice of taking out insurance policies on the lives of patients he was about to operate upon? It recently came to my knowledge that a business man had said, in all seriousness, that he was inclined to thoroughly believe certain statements of mine, *although* I was a mining engineer. The suggestion is grotesque, but of a truth the engineering profession cannot afford to yield up its one unassailable advantage of disinterestedness and expect the world to accept a lordly claim to infallibility.

I believe a blow has been struck, and unthinkingly repeated, against the most vital principles underlying the integrity of the profession. The issue should not be left in doubt. Is it not within the province of the Institution of Mining and Metallurgy to take this matter up, and settle the point, and so forever remove the possibility of such a term as "hypothetical professional ethics" being again employed in connection with our calling?

HORACE G. NICHOLS.

Johannesburg, February 1.

PRÉCIS OF TECHNOLOGY

The Price of Nickel.—The artificial maintenance of the price of nickel forms the subject of an interesting article in the *Canadian Mining Journal* for February 1. The general argument is that but for this high price the consumption would increase enormously. The metal would have many additional applications if the price were nearer that of copper, and both at Sudbury, Ontario, and in New Caledonia—these being the present sources of supply—there are sufficiently large reserves of ore to warrant working on an entirely different scale. From New Caledonia 15 million pounds of nickel, and from Sudbury 21 million pounds, are produced annually. The deposits at the former are controlled by the French company called the Société le Nickel, and the only producers at Sudbury are the International Nickel Co., of New York, and the Mond Nickel Co. It is usually assumed that the New York company exercises the control of the prices and market, by agreement or arrangement with the others. At any rate the supply of nickel is practically in the hands of a monopoly. It is interesting to know also that the price varies according to the customers. The governments of several nations and certain combinations of battle-ship builders are strong enough to bargain with the controllers and obtain nickel at about 26 cents per pound. Other firms that produce nickel-steel have to pay 35 cents and those that use nickel for the manufacture of white metal or for electro-plating have to pay anything from 35 to 60 cents. These prices are out of all proportion to the cost of production at Sudbury, where the figure cannot be much above 15 c. per lb. This statement is substantiated by the profits made by the two companies. The International Nickel Co. makes a profit of 3 million dollars per year on their output of 17 million pounds, and the Mond Nickel Co.'s profits exceed $550,000 on an output of 4 million pounds. The New Caledonia ores do not favour the producer so much. The ore is a silicate of nickel and magnesium; it is easily mined, but it cannot be smelted locally and cannot be concentrated by machine. It is therefore hand-picked up to 5½% and is shipped to European ports, where its cost is about 7 c. per lb. of metal in the ore. It is smelted with pyrite and gypsum to form a matte, from which the metal can be extracted with less trouble than from the nickel-copper mattes produced at Sudbury. As regards the present applications of the metal, it is estimated that two-thirds goes to the manufacture of nickel-steel, and the remainder to the production of white metal, coinage, and electro-plating. The nickel-steel contains about 3½% nickel and by far the larger proportion is used in connection with battleships. The application of nickel-steel for ordinary ship-plates, forgings, engine-work, and machinery would be possible if the price of the metal were substantially reduced.

Winding at City Deep.—The development of 'deep levels' on a large scale on the Rand has once more induced a discussion of the most economical and safe methods of bringing the miners to and from their work. The *South African Mining Journal* for January 22 devotes some space to the general question, and in particular gives details of the Whitford-Mills gear, which is to be adopted at the new hauling plant of the City Deep. In reviewing the subject, the writer quotes the views of H. H. Webb and Hennen Jennings as expressed when H. C. Behr's notable contribution was published in 1902, the latter having been in favour of the gradual replacement of the shifts without any interruption of hoisting the ore, while the former advocated the temporary cessation of hoisting the ore so that the full capacity of the shafts could be utilized for the rapid transport of men. At the City Deep, which is under the general management of W. W. Mein, Mr. Webb's principle has been adopted, and special gear has been invented for the purpose of changing from skip to cage with as little delay as possible, the transition from ore-hoisting to man-transport being thereby effected rapidly. The shaft has six hoisting compartments, of which two will be used solely for transporting the men and the remaining four can be used either for hoisting the ore or transporting the men. The cages in the two former will accommodate 60 men each and the latter 48 men each. The changing gear consists of a carriage travelling on rails, which are laid in line upon opposite sides of each hoisting-compartment. The main portion of the carriage consists of two steel side-plates 27 ft. 6 in. long, 4 ft. deep, and ½ in. thick, rigidly braced together and carried on two pairs of wheels, one of each pair of wheels resting on the rails on each side of the shaft. The side-plates are at a sufficient distance apart to permit the free passage of the skip between them when the gear is not in use. Upon one end of the carriage is borne a 3-deck cage with a capacity to hold 16 men on each floor, and upon the other end there is a platform that receives the skip when the latter is removed from the hauling rope. In making the change the skip is raised above the level of the rails and retained by 'dogs' and the platform end of the carriage is brought beneath it by a worm-gear connected with the hind wheels. The skip is lowered to the platform and unhooked, and the carriage is then moved back again so as to bring the cage to the centre of the shaft. During the travel the cage is hooked to the hauling rope and filled with men, and is immediately ready for its upward journey. When all six compartments are being used for transport of men the total load per trip will be 156, and allowing 3 minutes for each trip, including loading and discharge, it will be possible to transport 3120 men per hour. Whitford and Mills have also devised a new form of hopper for rapidly filling the skips. It is suspended from a pair of swinging arms at a point just above its centre of gravity. The descending skip tilts the hopper and receives its charge, and when ascending again lifts the hopper back into its place ready to receive another charge from the bin. This system is to be adopted at the main loading-station of the mine, where, at a depth of 3000 ft. there will be a bin having a capacity of 800 tons.

Galvanit.—At the meeting of the Royal Society of Arts held in London on February 2, Augustus Rosenberg read a paper on his new process for electro-plating. According to this process a prepared powder is sold in sealed tins and the operation consists of rubbing the powder by means of a damp rag upon the surface to be coated. The powders have been advertised largely and are said to be suitable for household purposes, though there is some substantial doubt as to the commercial value of the process. The subject nevertheless was received by the Society of Arts with scientific interest. The claim of the inventor is that he produces an electrolytic action in place. The idea is to make a mixture containing (1) the metal to be deposited, (2) a salt, preferably of ammonia, and (3) the electro-positive metal such as magnesium or zinc required to cause the electrolytic reaction. All these are in the form of powder. On moistening this mixture the reaction would take place rapidly and it is necessary to add some inert substance such as chalk, which would also serve the purpose of keeping the surface bright. In his paper the inventor discusses at length the reactions and proposed additions for producing various results. At the close of the meeting the inventor showed the deposition of silver upon various metals. Further experiment with this invention is desirable before judging of its value.

Production of Phosphates.—An article by Louis Aguillon in *Annales des Mines* is quoted in the *Revue de Metallurgie* for February. According to the author the world's production of natural phosphates has been doubled in ten years. In 1908 it was 5,218,000 metric tons with a content in tricalcic phosphate varying between 50 and 82%. Of the total, France produced 400,000, Algeria 360,000, and Tunis 1,258,000 tons. The tenour for France is 50% and for Africa 60%. In the same year the amount of natural phosphates consumed in France was 1,046,000 tons, this figure comprising both those used for metallurgical and for agricultural purposes. The slag from dephosphoration holds an important place in the history of phosphates. This has a tenour of 10 to 20% of phosphoric acid and is equivalent, weight for weight, with a super-phosphate. In the absence of other documents the figures of output have to be derived from the statistics of steel.

Year.	Belgium.	France.	Germany.	England.	Austria-Hungary.	Total.
1892	15,000	94,000	500,000	100,000	38,500	747,500
1899	,,	134,000	1,000,000	131,000	62,000	1,500,000 (?)
1907	325,000	405,000	1,804,000	96,000	,,	2,600,000 (?)

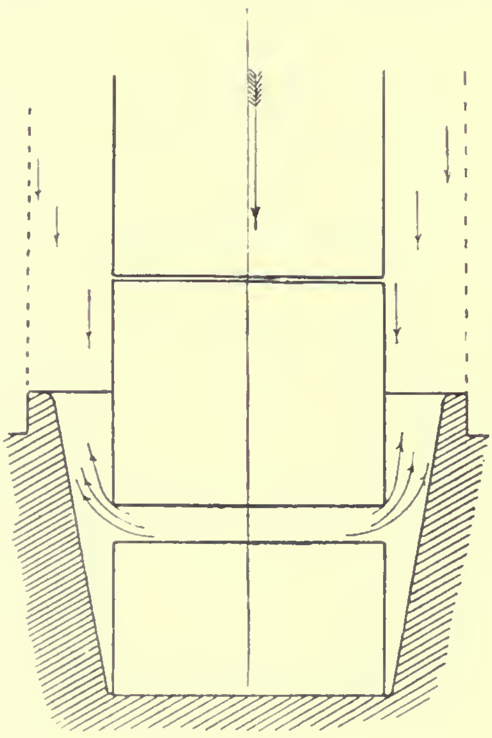
The slags from the open hearth basic process may be left out of account, as they are relatively poor, though in some cases even these find a ready market. In the basic bessemer process 250 kg. of commercial slag is produced per ton of metal obtained and from this can be deduced the accompanying table of production. Enormous as are these quantities, they cannot but increase, seeing the development that is taking place in the use of the basic bessemer process.

Acheson's Inventions and Researches.—The Perkin medal was presented to E. G. Acheson, of Niagara Falls, at the meeting of the New York section of the Society of Chemical Industry on January 21, when a representative gathering of chemists and metallurgists met to do honour to one of America's most successful scientists. C. F. Chandler in making the presentation gave an outline of Mr. Acheson's work and we quote in abstract the report of the speech appearing in the February issue of *Metallurgical and Chemical Engineering*. In 1886 Mr. Acheson found that if a hydrocarbon gas is passed over highly heated clay, the latter becomes impregnated with carbon. Subsequently in 1891, when he had at his disposal an electric furnace he repeated the experiment at a higher temperature. This treatment resulted in the production of small crystals which exhibited such extraordinary hardness as to form an abrasive that could cut the polished surface off a diamond. He sold a quantity of these crystals to a diamond polisher and with the proceeds purchased a microscope wherewith to study the subject more intimately. At first he made the incorrect surmise that the crystals were formed by the union of the alumina in the clay with the carbon, and accordingly named the product 'carborundum.' Further examination showed however that it was the silicon of the clay and not the alumina which had combined with the carbon and that the crystals were really composed of silicon carbide. Nevertheless the name carborundum was retained, and it occasionally gives rise to not a little mystification. In 1894 he established works at Monongahela, Pennsylvania, and later equipped a new plant at Niagara Falls, on a large scale, using 5000 electrical horse-power and employing 600 men. Up to the present time seven million pounds of carborundum has been produced, and used in the manufacture of abrasive discs, heat-resisting bricks, etc. The material is also used as a substitute for ferro-silicon. In pursuing further experiments with the carborundum furnace, he found that in the hottest zone next to the carbon core there was produced a thin layer of graphite. This he surmised was produced by the dissociation of a portion of the carborundum and the expulsion of its silicon as vapour. By developing the furnace on these lines he eventually was able to produce a hard artificial graphite and at the present time he is making large quantities of this material out of anthracite. In addition to what he calls 'bulk' graphite, he also prepares electrodes, by forming shapes out of the graphite and heating them again until they become hard and compact. These have a large sale for use in connection with electrolytic operations. Mr. Acheson's next discovery was the production of a soft unctuous graphite that would serve as a lubricant and as a polisher for iron surfaces. Finally he invented 'deflocculated' graphite, which is graphite in a colloidal form. The fact that this product will not settle either in water or in oil has been employed for the production of graphitized lubricants which will allow a shaft to rotate from 50 to 100% faster than plain oil. Another of Mr. Acheson's discoveries is siloxicon, a compound of silicon, carbon, and oxygen, applicable for the manufacture of crucibles and bricks. Mr. Acheson is not only an enterprising chemist but a successful man of business, combining in an unusual degree the scientific and commercial instincts. The substantial rewards which he has reaped from his professional labours bring him the sincere congratulations of his many friends.

Standardization of Assays. — The committee on standardization appointed by the Institution of Mining and Metallurgy has issued a report of their sub-committee, the chairman of which is George T. Holloway, on bullion and assay values. The recommendations are as follows: (1) Reports shall always state the exact condition of the sample as regards moisture. (2) Assay-values shall be represented in ounces and decimals or pennyweights and decimals, and not in ounces, pennyweights, and grains; they shall be expressed in fine gold and silver, and not as bullion. (3) Assay-values of alluvials shall be reported in grains and decimals of fine gold or in pence or cents per cubic yard, taking 2d. as the value of fine gold per grain; and a cubic yard of alluvial excluding boulders shall be taken as equal to 3000 lb. unless more specific information on this point is available. (4) In reporting assay-values of cyanide and other solutions, the results shall be given in parts by weight in a stated volume of the solution; in the case of cyanide solutions the use of the fluid ton of 32 cubic feet is recommended as approximating to 2000 lb. (5) When stating the money value of an ore other than of gold the estimate shall be accompanied by the assay-value, with an explanation of the method of deducing one from the other. The committee also urges that the reports should say whether the assays are done by fire or wet, and whether the metallic contents as disclosed by assay are recoverable commercially. The latter is an important point, for the public is apt to mistake assay-values for statements of available produce.

Nissen Stamps at Cobalt.—In the issue of the *Canadian Mining Journal* for February 1, some information is given relating to the performance of Nissen stamps recently erected by the Northern Customs

Concentrators Co. at Cobalt, Ontario. These stamps act by gravity and each is contained in an independent circular mortar. The screen is bent round into cylindrical form and its cross section consists of rather more than a semi-circle. By this arrangement the splash of the stamp is always at right angles to the screen, so that the discharge is more rapid. The relative efficiency of these stamps and ordinary stamps was ascertained at the Cobalt plant. Two stamps were erected and they were set to work on the dump-ore from the La Rose mine. The heads weighed each 1650 lb. and 30-mesh screens were used. The ore was conglomerate and extremely hard. A 24-hour trial showed that each head treated 5½ tons or 11 tons together. The ordinary battery, working on the same ore, consisted of five heads each weighing 1250 lb. and treated 11¼ tons in 24 hours. It will thus be seen that two Nissen stamps did nearly as much as five ordinary stamps. It was estimated that the power consumed by the two Nissen stamps was from 40 to 50% less than that required by the five ordinary stamps. The Nissen stamps dropped 100 times per minute and the height of drop was 7½ in. The two mortar-boxes weighed 6000 lb. as compared with 10,000 lb. for the 5-stamp box. It follows that the Nissen stamps should not have resilient foundations and in the present case it would have been better to place the mortar-boxes direct on concrete instead of upon timbers. The screen analyses of the products from both sets of stamps showed that a rather smaller proportion of *minus* 200 was produced by the Nissen stamps. The chief disadvantage of these stamps is that the direct impact of the splash on the screen tends to wear it out rapidly, but it is reported that in these trials the wear was not so great as was expected, though no exact figures are quoted.



The Boss Stamp.

The Boss Stamp.—In *Mines and Methods* for January, M. P. Boss, an old and experienced authority on stamp-mills, gives an outline of the theory of his individual stamp with circular screen. Much attention has been given in America during the last few years to the individual mortar-box applied to the gravity-stamp, the idea being that a more rapid discharge of the crushed ore will be obtained in this way. The individual mortar-box has, of course, been used in the steam-stamp and air-cushion stamp, but it is generally considered that these rapid machines are not desirable for use in connection with gold-milling for reasons that need not now be recapitulated. The combination of an individual mortar-box coupled with a gravity-stamp has been adopted by several engineers who argue that the benefit of rapid discharge will thus be obtained without losing any of the advantages known to be connected with the gravity-stamp. The Nissen stamp is one of these, but it is stated that owing to the impact of the splash at right angles to the screen the wear of the latter is excessive in practice. The Boss stamp has a complete circular screen, but the die is sunk sufficiently low in the mortar to be below the level of the screen. As will be seen from the accompanying illustration, the outrush from the falling stamp is immediately diverted upward. The upward flow is vigorous in proportion to the smallness of the available area of escape, and it is fastest at the outside edge. In the rapid recurrence of the splashes, each individual splash will meet the material of its predecessor on its downward return, but being more powerful will keep to the outside and allow the downward current to take the inner zone and so become subject to the suction of the rising stamp. It will thus be seen that there is a continuous flow of material, upward at the outside and downward at the inner side, and the material in contact with the screen always comes direct from between the shoe and die without any admixture from elsewhere, so that the screen can work with the greatest efficiency. Also seeing that the upward current has spent most of its violence by the time it arrives opposite the screen, the wear and tear of the latter is not liable to be so great. Mr. Boss therefore claims that his stamp produces a rapid discharge with a minimum of slime, without undue wear on the screen.

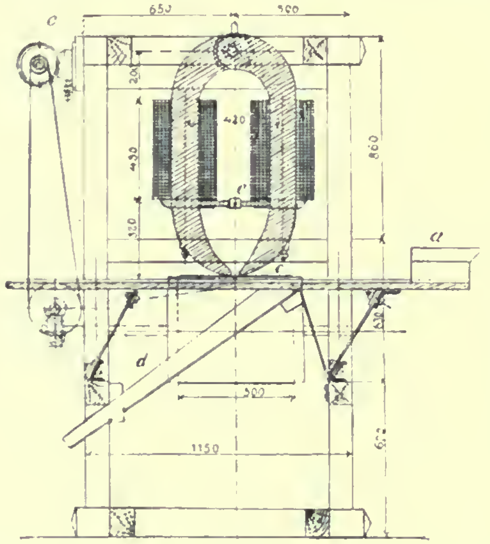
Economy of Steam at Mines. — At the February meeting of the Institution of Mining and Metallurgy a lengthy paper was presented by W. A. Macleod entitled 'The Surface Condenser in Mining Power Plant.' The author described the plant and the experiments in connection therewith at the Brilliant Extended mine at Charters Towers, Queensland. At a mine the power-plant always has an intermittent load. The air-compressors and dynamos take constant quantities of steam but the winding-engines are intermittent and irregular in their requirements. Hence the plan is to use non-condensing engines. The author in his paper shows how to use a surface-condensing plant to advantage under these circumstances, and he also discusses the effect of hot climate and high altitudes on the working of such plant. In Europe the question of utilizing irregular supplies of exhaust steam is being attacked from another point of view. At many collieries the exhaust-steam from the winding-engines is used to drive low-pressure steam-turbines, such a system being made possible by the recent invention of an effective accumulator which supplies a steady stream of steam to the turbines from the intermittent source. It is believed that this utilization is more economical than the action of surface-condensers, though how such turbines will answer in hot climates and high altitudes remains to be seen. Mr. Macleod's paper is intended to elicit discussion on the subject generally, and we prefer to refer those who are interested in the subject to the paper itself rather than provide an abstract in these columns.

Minute Traces of Gold.—At the January meeting of the Institute of Mining and Metallurgy, a paper was presented by A. R. Andrew on the detection of minute traces of gold in county rock. The discussion was taken at the February meeting, when Arthur C. Claudet contributed some interesting information relating to the difficulties encountered in the assay office when handling substances containing such minute quantities of gold. The investigations were made by Mr. Andrew at Birmingham University where he was doing research work in Professor Turner's metallurgical laboratory with the object of determining the existence of gold in county rock. The question was one connected with the geological department of the University and was part of a series of studies of North Wales rocks undertaken by Professor Lapworth. Mr. Andrew worked with samples weighing 300 grams, and had been able to identify and measure beads representing 0·0007 grains per ton of rock. The whole question was one of the purity of the litharge or lead salt, and he described his endeavours to prepare a material entirely free from gold. The discussion at the meeting centred round the question of the possibility of making such minute determinations and of preventing the introduction of gold through reagents or otherwise. Mr. Claudet commenced his remarks by saying that this class of investigation was outside the range of commercial assay work, and was more suited to research in a national laboratory where extraordinary precautions could be taken. In ordinary assay work he could not make estimations of 0·0007 gr. per ton; it would perplex him when working with as small quantities of material as mentioned by Mr. Andrew, namely 300 grams or ⅔ lb., to make an estimate of even 0·7 gr. per ton. The bead produced would be so small that it would be hard to find it at all, and the circumstances under which it was produced would be such that it would be impossible to tell how much of it would be volatilized. Extraordinary precautions would have to be taken to do the work in a place where no gold had ever been before; virtually an entirely new laboratory and fittings would have to be built. In Mr. Andrew's investigations the work was done in a laboratory where only iron and copper had been assayed and care was taken that the apparatus should be free from the presence of gold, but the cupellation was done in the furnace-room where there had been gold and silver before, so that the circumstances were not absolutely satisfactory. The great point, however, in connection with investigations of this sort is the difficulty of getting a lead compound quite free from gold. Mr. Claudet's advice was that in ordering the litharge, the manufacturer should be informed of the purpose for which it was to be used, and should be instructed to take only the second third of litharge that goes over the cupel. This middle third is the freest from gold of any part of the charge. For research purposes this middle third should be worked over again and its middle third extracted. If possible this fractionation may be continued indefinitely. As an alternative method for estimating the gold in a rock, Mr. Claudet recommended the treatment of the rock, ground extremely fine and in large quantities, by a solution of nitro-hydrochloric acid. This would be more satisfactory from the point of view of enabling the experimenter to handle far larger quantities of rock and at the same time obviate the litharge difficulty.

In speaking of estimating small quantities of gold in an ore, Mr. Claudet, in reply to a question put by the president, said that the usual meaning of a 'trace' when used in an assayer's report usually meant anything less than 6 gr. or ¼ dwt. This was the largest amount that could be weighed without taking special precautions, when the usual amount of ore was being used in the assay. Such contents were of no commercial value, so that unless special circumstances required a more exact determination, no nearer figure need be given. Of course this did not apply to alluvial.

Abercorn District.—In the *South African Mining Journal* for January 15, E. M. Weston gives an account of the geography and geology of the Abercorn district of Rhodesia and of the Shamva mine, which have attracted attention during the last few months. Shamva Hill is one of a series rising 800 ft. above the surrounding valley of the Mazoe, and is situated three miles south of the junction of the Mazoe and Poli rivers. The district is between 3000 and 3500 ft. above the sea but is unhealthy and flat in the valleys. The Poli is only a series of small pools in the dry season and the Mazoe is a slow-running stream between larger pools. The water-supply will be a troublesome matter and it will be necessary either to construct reservoirs or bring water from the Inyagui river, which runs further east and is a more permanent and more rapid stream. Timber is scarce in the neighbourhood and much of what was found there has been used for fuel at the small crushing-plants of the six or so mines in the district. The gold deposits are found in a series of quartzites, ironstone, and conglomerates dipping at a high angle, and lying between masses of hornblendic granite on the Inyagui river on the south and on the Umfurudzi valley on northeast. Farther east the granite masses unite and the quartzites disappear. Between the granite and the quartzite there are found extensive intrusions of diorite-porphyry, and strong dikes of diorite of more than one variety traverse both the granite and the sedimentary rocks. The series of rocks is thick and contains many beds or bands of conglomerate. These bands occur in some places as lenses and at others are continuous over great distances. It is also frequently found that layers of quartzite, ironstone, and conglomerate appear as interwoven lenses. The ironstone is a ferruginous sandstone and has been formed by the decomposition of the quartzite. The iron exists as limonite and is the oxidation product of pyrite finely disseminated throughout the quartzite. The conglomerate consists of rounded pebbles varying according to the district; sometimes the pebbles are of chert, sometimes quartz, and sometimes granite. The gold exists in all the formations, granite, quartzite, ironstone, and conglomerate. In every case examined by Mr. Weston the orebodies are always connected with the diorite dikes. In his opinion the intrusion of these dikes was accompanied by the rise of heated waters strongly impregnated with silica, which re-silicified some of the quartzite beds and filled fractures in them. In certain places the rising solutions were auriferous and were accompanied also by iron sulphides. In the case of the Shamva orebody it would appear that the rocks here were porous over a considerable width, so that the auriferous solutions were distributed widely. This porosity of the rock seems certain, because the solutions have been so widely distributed that the resulting deposit of gold is attenuated. The orebodies are decidedly low-grade but extensive. The average assays range from one to four pennyweights, and it is probable that in mining this deposit anything over 2 dwt. will be sent to the mill. As the work can be done by open-cut, and the rock is not particularly hard, the cost of mining and treatment will be between 4 and 6 shillings per ton. The deposits at Shamva are not virgin for there are many ancient workings along the outcrop. On the other hand, the extensive tracts of untried ground at present covered with surface soil might pay to prospect by trenching. As regards the nature of the conglomerate, Mr. Weston does not consider it at all analogous to the Rand 'banket,' and in fact, the presence of the conglomerate at any place is no evidence of the presence of gold.

Magnetic Separation at Monteponi. —The latest form of his magnetic separator is described by E. Ferraris in *Berg und Hüttenwesen* No. 30, 1909. It is at work on the zinc works at Monteponi, Sardinia. The calamine ore there is an intimate mixture of zinc and iron carbonates along with zinc-bearing dolomites of nearly the same specific gravity. The ore is first slightly roasted to render the iron magnetic; this is removed and the remaining zinc and dolomite are separated by jigging. The furnaces are fired by producer gas, the air entering the furnace being heated by first passing along the outside, and over the roasted ore



as it leaves the discharge doors. The total cost of roasting is only 3.8 fr. per ton. The magnetic separator used is shown in section in the figure. The ore is discharged through the hopper *(a)*, on to the shaking table driven by a small motor, and is so moved along under the magnet, where the magnetic portion is pulled up against the underside of the moving belt *(c)*. When removed from the action of the field it drops into the shute *(d)*. A single-magnet machine treats 12 tons of ore per 24 hours using 100 watts. A larger machine with six magnets of varying strengths makes it possible to treat materials of very uneven size. The product from each magnet is uniform in size. Thus the machine performs the duties of both classifier and separator.

Measurement of Crushed Stone. — In *Bulletin No. 23* published by the University of Illinois, Ira O. Baker, professor of civil engineering, presents some useful calculations relating to the volumes and weights of crushed stone, the volume of the interstices or voids, and the amount of settlement due to agitation during transit or otherwise. The investigations were undertaken in connection with stone used in macadam and concrete, but the information given in the paper is of interest also to the mining engineer in estimating tonnage per volume, the calculation of solid contents in leaching tanks, and other analogous purposes. The experiments were conducted with limestones at the Chester, Joliet, and Kankakee quarries, and their respective specific gravities were found to be 2·57, 2·71, and 2·61. A series of experiments were conducted with the object of ascertaining the absorptive power of the broken stone. This was found by immersing the stone in water for 4 days and comparing the weights before and after. The figures showed that Chester stone absorbed 1·01% by weight or 1·67 lb. per cu. ft.; Joliet stone 0·64% by weight or 1·09 lb. per cu. ft.; and Kankakee 1·84% by weight or 3·04 lb. per cu. ft.

The next experiments related to the calculation of interstitial space. These were divided into two parts (1) estimation by pouring water, and (2) by computation from the specific gravity and the weight of a volume of broken stone. In carrying out the first method, the procedure is to fill a vessel with broken stone and find how much water can be poured in. The ratio of the total volume of the vessel to the amount poured in gives the proportion of interstitial space. There are three possible sources of error. First, the stone may absorb water if the process is prolonged, second, it is not easy to tell when the vessel is exactly full if the mouth is wide, and third, air bubbles may be trapped. The last point might be remedied by pouring the stone into water instead of the water into the stone, but this might also be unsatisfactory as the stone would pack differently under the two different conditions. The method of ascertaining the voids by computation consists of determining the weight of a certain volume of broken stone, then computing the weight of an equal volume of the solid stone by multiplying the known volume by the weight of an equal volume of water and by the specific gravity of the stone. The difference between the weight of the volume of the solid stone and that of the broken stone is the weight of stone equal to the volume of the voids. From this the ratio of the voids can be deduced. This method is subject to the error of determining when the vessel is exactly full of stone. In practice it is more complicated than the direct method but it is more exact.

In experimenting on Chester stone two different size vessels were used, one with a capacity of 27 cu. ft. and the other 2·6 cu. ft. With the larger vessel the filling was done by a 15 ft. drop. With stone passing ¾ in. screen the voids were found by the first method to be 42% and by the second method 43·4%. With stone from ¾ in. to 2 in. the figures were 46·8% and 46·1%; and for stone from 2 in. to 3 in. 47% and 45%. With the smaller vessel, the averages were much the same, though as might be expected the variation was within wider limits. The results with Joliet and Kankakee were not greatly different, but the methods of filling were not the same, and with higher drops the interstitial spaces were a trifle less. With the smaller stone the first method gave lower figures for the voids than the second method, showing probably the greater amount of trapping of air bubbles.

The investigation relating to the settlement of crushed stone by shaking was undertaken in connection with transit by road wagons and by railway cars. In the wagon tests the hauling was suspended every 100 ft. and measurements made of the decreased volumes. With Chester stone a load of ¾ in. screen settled by 7% during the first 100 feet, and the succeeding hundred feet caused a further gradual settlement until at half a mile the volume was 11% less than at first. With larger size stone the first hundred feet saw settlements varying from 3 to 5½%, and total settlements at half a mile of from 5 to 9%. The results on this and the other stones varied considerably according to the method of filling the wagons and the nature of the road over which the hauling was done, but under ordinary circumstances and over average roads the total settlement was from 6 to 10%. Mr. Baker also gives the results of investigations relating to the settlement of stone in railway cars, but as in these operations he was at the mercy of the railway companies the conditions were such that the results are not conclusive or reliable. Nevertheless the figures as far as they go are much the same as with wagons.

Mr. Baker has also conducted investigations as to the weight per volume of crushed stone loose and packed. These were done in railway cars the cubic contents and weights of which were known. The weight of the contents was ascertained and the volumes at the beginning and end of the journey measured. From these could be deduced the weights of a cubic yard of loose and packed stone. On Chester limestone it was found that the average weights of one cubic yard of ¾ in. screening were 2453 lb. loose and 2819 lb. packed. Similar figures for ¾ in. to 2 in. material were 2444 lb. and 2582 lb.; and for 2 in. to 3 in. material 2367 lb. and 2570 lb.

Extraction of Zinc from Slag.—A method in use at the lower Harz mines of Oker is described in *Gluckauf* of February 19 by Dr. Pape. The ore is taken from the Rammelsberg orebodies, the main varieties being lead ores with 9% lead and 20% zinc, and copper ores with from 1 to 15% Cu. and 1 to 20% Zn. These are treated in the ordinary way in blast-furnaces, the lead ore after a sulphating roast to remove some of the zinc by leaching. The slags resulting have the composition: ZnO, 22 to 27%; FeO, 30 to 16%; SiO_2, 23 to 9%; and BaO, 7 to 26%. About 42,000 lb. of slag is formed every year. In the works erected for the purpose at Oker, as the result of a long series of trials, the slag is ground to 50-mesh, and then mixed with coke dust, and briquetted. The briquettes are reduced in a continuous reverberatory furnace where the zinc after volatilization as metal is carried off as oxide by the flue-gases. To precipitate this, the gases are passed through a stone channel, to 12 water-tube boilers having their temperature reduced from 1000° C to about 280° C, and fans draw them through two iron towers to the bag-houses, before passing through which they are diluted with cold air to further reduce their temperature, to prevent injury to the bags. The oxide caught in the bags is the finest and is sold as a pigment; the rest is sent to a local works where it is used for enriching poor zinc ores in order that they may be treated by the Belgian process.

Nickel-Iron Storage-Battery.—From time to time during the last ten years the technical and daily Press has contained notices of the new storage-battery invented by Edison, the virtue of the invention being that it is much lighter and stronger than the ordinary storage-battery made of lead and sulphuric acid. It was stated that the new battery employed nickel in the construction of the electrodes, but no precise details of construction were given. The article in the *Electrical World* for January 20 will therefore be of interest, as it describes in detail the perfected form of the battery now being used on an experimental tram-car at Orange, New Jersey. The active material of the positive pole is nickel oxide and of the negative pole iron oxide. The electrolyte is potassium hydrate in the form of a 21% solution: a small amount of lithium hydrate is also added to the electrolyte, as it is found to improve the working of the positive pole. The specific gravity of the solution is 1·21. In the battery as used on the tram-car each cell measures approximately 13½ in. high, 5 in. wide, and 2½ in. thick, and its weight complete is 13½ lb. The cell gives about 190 watt-hours per charge and the rated ampere-hour output is 150. The tram-car is of the single-deck type with a seating capacity of 26, and the battery consists of 200 cells, with an additional 10 for lighting. The cell is made of nickel-plated steel and the walls are corrugated to give structural strength. The positive or nickel pole is made of rows of small thin perforated steel tubes, containing nickel oxide, to which flakes of metallic nickel are added, for the purpose of increasing the conductivity. The negative or iron pole consists of a series of rectangular pockets made of nickel-plated steel which is perforated with fine holes, each pocket being filled with oxide of iron.

Mine Subsidences.—In our issue for December last we gave some particulars of the proposed method for packing old stopes on the Rand. This new departure has drawn attention once more to the general question of the safety of the workings, and the *South African Mining Journal* for February 5 devotes some space to the subject, more especially in connection with the safety of shafts. Some weeks ago there was an accident at Ferreira Deep, indicating that sufficient ground had not been left intact in the neighbourhood of the shaft. In order to remedy the defect concrete pillars are being provided. Similarly weakness has been discovered at the Robinson Deep, just to the South of Ferreira Deep, and in order to prevent any collapse a large concrete pillar has been built. In connection with the Jupiter, at which mine the shafts are unusually deep, a pillar 500 ft. in diameter has been left round them, while at the Cinderella Deep, where there is only one shaft, a pillar 600 ft. in diameter is to be left. These supports may be considered unnecessarily large, and the policy of leaving so much ore in the mine may be debated, but the engineers would hardly have adopted such a policy without good reason. Another point in connection with the safety of the mines that has arisen lately is the question of the advisability of working under the battery foundations. The stamps are so heavy and the plant so extensive nowadays that the vibration is felt a long way down. For instance, at the Simmer and Jack, vibration of the 320-stamps can be felt in the hanging wall 300 ft. below the surface although strong pillars have been left. It is generally considered that, having regard to the heavier machinery and the larger reduction plants, it will be necessary to make close inquiry into the state of the workings at many of the older mines.

Stamp-Mills at Bendigo.—In the *Australian Mining Standard* for January 26, Donald Clark reviews the present practice of stamp-milling at Bendigo, Victoria, and points out that metallurgy is at a standstill; in fact, that there is little or no alteration in the methods described in T. A. Rickard's book on the stamp-milling of gold ores. A prejudice still exists against heavy fast-running stamps, it being argued that in such plant the time is not sufficient for amalgamation in the mortar-box and that the plates would not be big enough for so large an output. On the other hand the mill managers continue the practice of scaling the plates, though it is perfectly well known that the amount of gold caught for sometime afterward is small. Nor are liners ever used in the mortar-boxes; instead, the metal of the boxes is made thicker, and the whole thickness is worn through before any repair is done.

COMPANY REPORTS

De Beers Consolidated Mines.—The 21st annual report of this company covers the year ended June 30, last. The period under review was a time of depression in the diamond business, as will be remembered, and the year was by comparison the worst on record for the De Beers company. The diamond account showed receipts of £3,074,911, which is £2,000,000 less than the average in recent years, and is £3,500,000 less than two years ago. The figure for the past year does not represent entirely receipts from sales, for included in it is a sum between two and three hundred thousand pounds representing the increase in the stock of diamonds taken at cost price. Interest on investments and other items of income brought the revenue for the year to £3,218,461 ; against this £1,648,263 was the cost of mining operations and administration, £237,142 was allowed for depreciation, £224,400 was spent in redeeming debentures, and £256,244 was paid as interest on debentures and on the capital of leased companies, making a total ordinary expenditure of £2,366,049. It has been deemed advisable to write down the value of stocks of blue ground under treatment so that the ground shall in future stand in the books at the cost of depositing on the floors, and with this object £619,809 has been written off. Taxes in Africa and England absorb £133,742 and £800,000 has been paid as dividend on the preference shares. The deferred shares have received nothing for the year. Owing to the decrease in the stock of blue ground on the floors during the year it has been necessary to transfer £313,602 from reserve to revenue account. The year began with a balance of £563,810 and the amount carried forward at the end of the year was £176,272. It will be seen therefore that the profits actually made during the year were not sufficient to provide the full dividend on the preference shares and the shortage was provided out of undivided profits from the previous years. It should be interpolated here that the capital of the company consists of 800,000 preference shares at £2. 10s. each, and 1,000,000 deferred shares at £2 10s. each. The preference shares are entitled to a cumulative 40% dividend During the last few years the dividends on the deferred shares have averaged 45%. There were also debentures and similar obligations outstanding on June 30, amounting to £3,143,695, since reduced to £2,905,695. There is a reserve fund of £991,728 invested in consols.

The chairman, Francis Oats, in his address at the meeting of shareholders, reported that since the close of the year covered by the report the affairs of the company have greatly improved. Referring to the report, it is seen that the De Beers and Dutoitspan mines were closed for practically the whole period, and that the mining operations were confined to the Kimberley, Wesselton, and Bultfontein, the amounts raised being respectively 434,403 loads, 1,853,562 loads, and 1,214,301 loads, a total of 3,557,975 loads as compared with 5,497,782 loads during the previous year. A 'load' weighs 1600 lb The quantity of blue ground washed during the year at the floors belonging to De Beers, Kimberley, Wesselton, and Bultfontein were respectively 249,325 loads, 1,153,569 loads, 1,798,160 loads, and 1,573,118 loads, or a total of 4,774,172 loads as compared with 4,965,323 loads a year ago The average yield has been 0 42 carat per load at De Beers and Kimberley, 0 34 carat at Wesselton, and 0·38 carat at Bultfontein The cost of mining at Kimberley was 4s. 9d per load, and of washing 2s. 2d. per load. Similar figures for Wesselton and Bultfontein were 3s. 3d. and 1s. 2d., and 5s. 2d. and 1s. 5d. All the floors have reserves of blue ground ready for treatment except at Kimberley, where the method of disintegration is being charged from weathering to crushing. The stock has accordingly been worked off, and in future the ground coming from the mine will be sent direct to gyratory breakers. Mr. Oats in his speech discussed the question of the life of the various mines and contradicted the adverse rumours that are circulated from time to time. The rumours at present current are to the effect that as the pipes are now in the granite at the Kimberley mine the occurrence of diamonds in the blue ground will cease. Mr. Oats stated that the prospecting and developing work has been conducted for a depth of 500 ft. in the granite without any indication of a variation in the diamond content, and that so far as he is aware the surrounding rock, whether shale, melaphyre, quartzite, or granite, has no influence on the existence of diamonds in the pipes.

Falmouth Consolidated.—This company was formed in February 1907, by the group now identified with the National Minerals Corporation, for the purpose of acquiring the old tin mines known as the Wheal Jane situated between Truro and Chacewater, Cornwall. The issued capital is £119,683, of which £75,000 in shares represent the purchase price. The treatment plant at first erected included ball-mills, which after erection were reported unsatisfactory, and a 20-stamp mill has been substituted. For the purpose of providing the new plant £34,050 in 6% debentures was issued. At the meeting of shareholders held on February 11, it was announced that the stamp-mill would be ready to start work on March 1. As regards ore reserves, we prefer to quote the chairman : " The step to be taken so soon as the mill is in active operation is that of adding further units and thus augmenting our crushing capacity with a result that will leave no doubt as to the success of the company. There is no question as to the ore being there. The confidence expressed by your responsible representatives is as undiminished as ever and in the opinion of the company's engineers the mine is of sufficient capacity to eventually keep supplied 500 or even as many as 1000 stamps." Surely the shareholders are entitled to a more precise statement than this magniloquent inexactitude?

Oil and Ozokerite.—This company has been formed to acquire as going concerns certain properties in Galicia, Austria. These consist of two ozokerite mines at Boryslaw, and petroleum land on the Tustanoivice oilfield. The capital of the company is £1,450,000, divided into 950,000 cumulative 7% preference shares and 500,000 ordinary shares ; there are also £800,000 6% debentures. The preference shares are entitled to one half of each year's profits over and above the 7%. The whole of the preference shares and debentures are offered for public subscription, but 500,000 of the preference shares have been underwritten in France. The price to be paid for the properties is £1,550,000, of which £318,000 is to be in cash, £532,000 in debentures, £200,000 in preference shares, and £500,000 in ordinary shares ; if the public responds to the issue, cash may be taken by the vendors instead of the preference shares and debentures. The properties have been examined by Sir Boverton Redwood, E. R. Blundstone, A. W. Eastlake, J. E. Marshall Hall, and William Sutton. Mr. Blundstone estimates a yearly income of £79,000 from ozokerite and £576,000 from the petroleum, and a profit of £430,000.

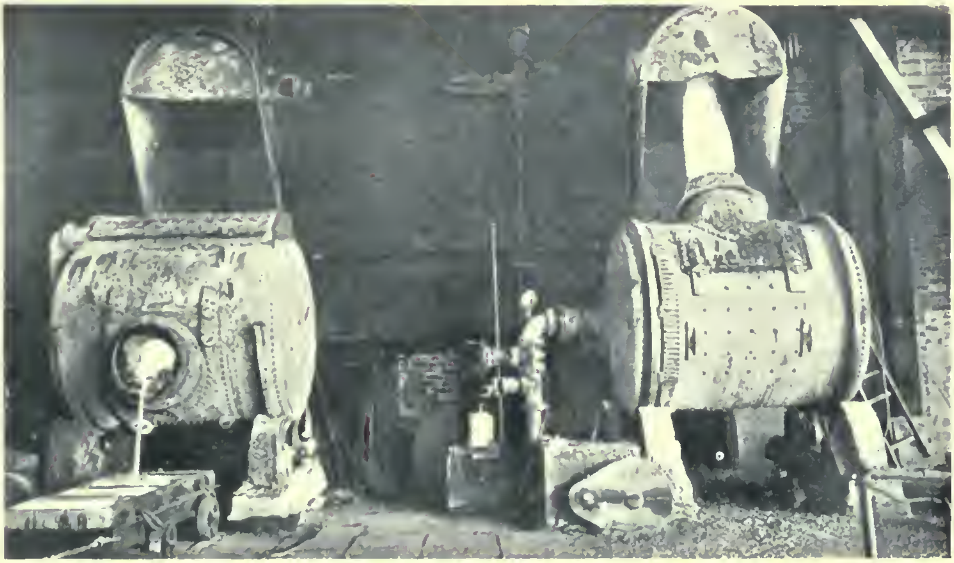
There are eight wells on the estate and they have been equipped by the vendors so as to produce 600 tons of oil per day. It is estimated that the property would provide sufficient supply for 100 wells in all and the estimate for the new company is that 24 wells will be in regular commission producing at least 288,000 tons of oil per annum, subsequently providing for five new wells every year to make good the failing yield of these existing. If the present issue is fully subscribed it is intended to spend £540,000 on new wells and refining plant. It is stated in the prospectus that the petroleum industry of Galicia has been in a discouraging state for a few years back, owing to over-production, but the recent establishment of a union among producers has restored a better condition of affairs, and the securing of the patronage of the State railways has provided a regular source of demand. With regard to the ozokerite mines, it should be mentioned that this substance is a natural paraffin wax that can be mined like any other mineral. It is stated that the sale price averages £55 per ton at the mine and that the cost is £40 per ton. The two mines together are producing about 2200 tons per annum, and it is estimated that there are 80,000 tons ready to be extracted. The ultimate yield of the properties is expected to be 185,000 tons. The use of ozokerite is spreading, for the manufacture of artificial bees-wax, candles, insulating material, etc. The only other part of the world beside Galicia where it is found in commercial quantities is in Utah.

Carn Brea and Tincroft.—This company, which is the second largest producer of tin in Cornwall, has issued its report for the latter half of 1909. It is a disappointment to find that the increase in the production noticeable during the second half of 1908 and the first half of 1909 has not been maintained owing to the lower contents of the ore mined. Though the amount of ore treated is larger than ever before, being 37,813 tons as compared with 34,790 during the second half of 1908 and 36,825 tons during the first half of 1909, the extraction has only been 29·52 lb. of tin concentrate per ton, as compared with 34·55 lb and 33·4 lb. during the two previous half-years. Consequently, though the average price per ton has increased to £72 as compared with £69 and £68, the total income has been only £35,888 as compared with £39,428 and £35,518. Other small items of income from arsenic and copper ores brought the total income to £39,006. Against this the mining expenses were £41,266 and the lords' dues £1398, leaving a loss on the year's operations of £3657. The cost per ton of ore treated was 22s. 7d. The directors' report shows that development work has about kept pace with the extraction and it does not appear probable that the current year's operations will show any marked improvement.

Ferreira Deep.—The report covers the year ended September 30 last. The company belongs to the Wernher-Beit group. The property is on the dip of the Ferreira and is a comparatively small one, owning only 97 acres of mineral-bearing land; but it is one of the most prosperous on the Rand. Operations commenced in 1899 and were resumed after the war in 1902. The original plant consisted of 50 stamps, and expansions in the scale of operations gradually brought up the capacity to 160 stamps and 4 tube-mills. During the last year or two the profits have been increasing, and for the year under review they amounted to £609,878. Out of this £477,750 has been paid as dividend at the rate of 52½% on the capital £910,000. The previous dividends, commencing with the year ended September 30, 1903, have been 10, 25, 30, 35, 35, and 40%, so that the total distribution has been 227½% or £2,070,250. During the year under review, 468,320 tons were raised, and after removing 49,853 tons of waste, the amount sent to the mill was 418,467 tons. The estimated content of the feed was 11·294 dwt. and the yield in the mill was 156,458 oz. or 7·485 dwt. per ton. The cyanide plant treated 415,335 tons and produced 69,137 oz. or 3·329 dwt. per ton leaving 0·48 dwt. in the tailing. The total extraction was 95½% and the amount of gold won was 225,589 oz. valued at £948,577. The expenses of mining were £198,945, development £26,690, milling and cyaniding £88,485, and general £24,578, bringing the total to £338,698. The extraction per ton was 10·792 dwt. or 45s. 4½d., and the expenses 16s. 2½d. per ton. The extraction is less by 3s. than during the previous year, and the cost has decreased by 1s. 5½d. At the same time the total tonnage treated has increased by 54,762 tons. The ore reserve at September 30 was estimated at 1,724,257 tons, of which half assays 10·2 dwt. and the remainder 9 dwt.; this reserve is over 200,000 tons greater than a year ago. Judging from the area of the ground available, the possible life of the mine will be at least another 15 years.

South Kalgurli.—This property is situated between the Kalgurli, Hainault, and Great Boulder Perseverance mines, at Kalgoorlie, Western Australia. Metallurgical treatment commenced in 1900, but new plant had to be supplied in 1905. The process now employed is similar to that in use elsewhere in the district, namely stamp-milling, roasting, fine grinding, and cyaniding with agitation. For the last few years Bewick, Moreing & Co. have been managers, but the appointment terminated on September 30. John Morgan, who had been superintendent, then became general manager. The ore is of low-grade, not averaging more than 7 dwt. per ton. The capital of the company is £200,000, and dividends commenced in 1906. The report just issued covers the year ended September 30 last. From this it appears that 108,430 tons were treated during the year with a production of 34,515 oz. gold and 2780 oz. silver, with a total value of £150,029. The extraction was 6·53 dwt. per ton, and the estimated contents was 6·97 dwt. The cost at the mine was £117,130; the allowance for depreciation was £7053; taxes and London expenses, £3291. There were receipts amounting to £1648 in addition to the income from bullion, so that the balance of profit was £24,172. Out of this, dividends absorbing £20,000 have been paid. It is reported that on September 30 the reserve of ore was 156,939 tons averaging 6·97 dwt., and there was also 'probable' ore estimated at 148,174 tons and containing 6·03 dwt. per ton.

Mount Morgan.—The directors of this company have issued the usual interim report for the half year ended November 30 last. The mine is situated near Rockhampton, Queensland, and is now a large producer of copper as well as gold. In writing a review of the yearly report of this company in our September issue we showed that owing to the interruption of operations due to creeps the full advantage of the extended copper-smelting plant had not then been made manifest. The present report shows that the mine has once more been made safe and that the new policy of filling stopes with waste is expected to prevent the recurrence of caving. Work has proceeded without interruption during the half-year in question and the figures show the increase in output. The copper-smelting plant treated 119,481 tons, yielding 3513 tons of blister copper and 55,474 oz. gold. These figures are about 20% higher than those for the corresponding half-year in 1908. In the chlorination plant 65,746 tons of pyritic ore yielded 28,614 oz. of gold and 175 tons of copper precipitate. This precipitate was afterwards put into the furnace-charge and the metal produced is included in the 3513 tons mentioned above. The plant for treating oxidized ore produced 8938 oz. gold from 28,847 tons; there is not much of this class of ore left. The total production was therefore 93,026 oz. gold and 3513 tons of blister copper. Some interesting figures are given in connection with the copper ores and the furnace-charges. From the commencement of smelting operations, at the end of 1903, the average yield of the ore has been 3·006% copper and 8·462 dwt. gold, and during the half-year under review the figures were 2·94% copper and 9·285 dwt. gold. The ore is silicious and requires the addition of iron and limestone flux. The average amount of charge required to produce one ton of copper has been: Ore 35·4 tons, limestone 18·01 tons, ironstone 6·38 tons, coke 5·56 tons, and converter lining 1·15 tons. The total amount of ore and fluxes put through the furnaces from the commencement has been 1,044,726 tons, giving a yield of 17,132 tons copper and 241,017 oz. gold. The contents of the furnace-charge have therefore averaged 1·639 copper and 4·614 dwt. gold. The converter-plant is at present being enlarged to provide for the increased quantity of matte that will be produced when the ore from the Many



COPPER CONVERTERS, MOUNT MORGAN.

Peaks mine is used in smelting instead of the barren fluxes employed at present. It is expected that this ore will be available during the next few months, the exact date depending on the completion of the necessary railway. With regard to the chlorination plant, there is nothing new to report. The oxidized-ore plant is now partly closed down, in fact, only one of the four units is at work, owing to the depletion of this material. With a smaller plant at work it has been possible to pick the remaining ore more closely, so that the yield per ton has been higher, the figure being 4·6 dwt. as compared with 3·19 dwt. during the previous six months. As regards the ore reserve, the development during the half-year has proved the existence of a further supply of 453,385 tons of smelting ore averaging 3½% copper and 8 dwt. gold. The total reserve of this grade is approximately 1¾ million tons which will keep the smelting plant occupied for seven years. There are also other blocks of lower grade but profitable ore. No development has been done on the chlorination ores during the half-year and no estimate of these resources has been made recently. The revenue for the half-year has been £545,918 and the expenditure £297,795. Out of the profit £100,000 has been distributed as dividend, which is at the rate of 20% per annum, and £24,706 has been allowed for depreciation of plant. The directors report that they have large stores of coal and coke on hand and they do not anticipate that the coal-strike will cause them any trouble at the mine. The strike has, however, interfered with shipping facilities and it has been impossible to despatch the blister copper to Port Kembla for refining with the desired regularity.

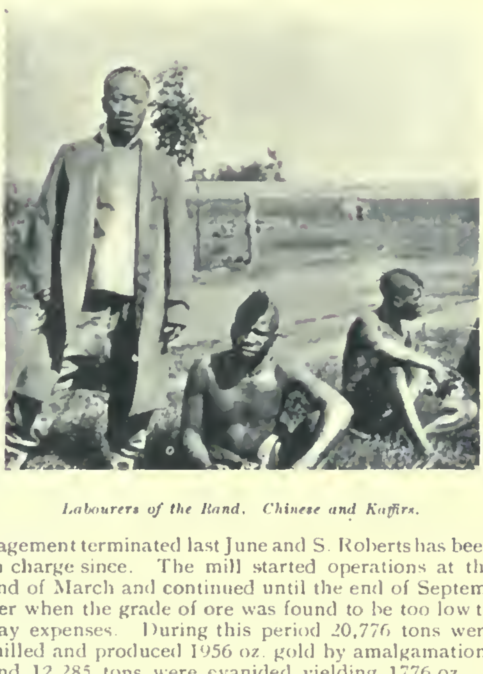
New Lisbon-Berlyn.—This company was originally formed in 1885 to acquire the two properties of this name at Pilgrim's Rest, in the Lydenburg district of the Transvaal. Later the Frankfort property was also acquired and this is the only one that has been worked for some time. The company has not been a prosperous one and has been reconstructed no less than five times. E. T. McCarthy is now the consulting engineer and during the past year G. Edgar Busch has been manager. It was Mr. Busch's task to make a thorough examination of the Frankfort property and to investigate the problem of treatment. His experiments with the old plant have been sufficiently satisfactory to warrant him in recommending the erection of a modern mill. Accordingly, arrangements are now being made for the issue of a further block of shares. The capital of the company is £156,250, in 1,250,000 shares of 2s. 6d. each. Of these 725,007 had been issued and fully paid at the date of the balance-sheet now published, September 30 last. Of the remainder 200,000 have been issued to provide the funds to carry out Mr. Busch's recommendations, and the subscribers have acquired the option over the other 324,993 shares until July of next year. The new plant consists of 20 stamps, a tube-mill, and cyanide equipment, and it is expected to be in operation within the next month or two. Mr. Busch has since resigned and the management of the mine and mill will be undertaken by his assistant Charles Hunter.

The Frankfort formation consists of orebodies in the nature of beds having a dip of about 9°. There are two principal beds, Theta and Bevitt's, the former in the dolomite and the latter in the Pretoria shale, 250 ft. above the former and practically at the junction of the shale and the dolomite. They lie conformably to the bedding of the surrounding rocks and are intercalated with them. The quantity of ore is great, for the outcrops are continuous over a large area. At the outcrops the ore is oxidized and as the dip is followed the workings come into pyritic ore. There is no knowing how far down the deposits extend, but the developments so far have been sufficient to prove the existence of large bodies; in fact, Mr. Busch goes so far as to use the word 'inexhaustible,' which, of course must have been used in its colloquial rather than its exact sense. The point to be considered in the development of ground is that the content varies and the skill of the engineer will be required to pick out the portions that are profitable. Of the two deposits, the Theta is much the most promising. Here 6240 tons of oxidized ore are ready for stoping and the content averages 13½ dwt. At Bevitt's the content is lower and the ore actually ready for extraction does not amount to more than 1000 tons averaging 6 dwt. per ton. In the experimental crushings with the old plant an extraction of 80 to 85% was obtained. This machinery is in a battered and decrepit condition, so there is reason to expect that a new plant will give better results. As regards the pyritic ore, it is certain that cyanidation without roasting will not answer, so the new plant will provide for roasting and classification into sand and slime. The ultimate shape that the cyanide plant assumes will depend on the result of experiments.

South Crofty.—This mine is situated in Cornwall and is on the opposite side of the Red river to Dolcoath. The present company was formed in 1906 by the London financiers known as the Allen-Meyerstein group. The mine had been worked for many years previously but had not done well owing to shortness of capital and the complex nature of the ore. The new company provided funds for development and for a new dressing plant in which the wolfram is removed from the tin by magnetic concentration. The capital is £50,000. On flotation the vendors received 20,000 shares credited 15s. paid with a liability of 5s., and the promoters subscribed for 20,000 shares at par. In 1907 and 1908 the remaining 10,000 shares were issued at £4 per share. The total cash capital subscribed was therefore £65,000. The company has sunk a new main shaft and has by instalments provided 60 stamps, together with tables and magnetic separators. The ore is hard and complex, containing tin, wolfram, and arsenical pyrite. For some time the mine has been paying its way, and for the year 1909 a dividend of 3s. per share has been distributed, equivalent to a return of 15% to those who obtained their shares at par, and 3¾% to those who paid £4. The report for the year 1909 shows that the production for the year was 696 tons of tin concentrate valued at £53,481, 142 tons of wolfram valued at £12,462 and 666 tons of refined arsenic valued £6950. The actual receipts during the year from sales were slightly different from the value of the production, being £52,669, £13,936, and £7442, respectively, making a total income of £74,223. The cost of mining and dressing was £58,469 while London expenses came to £1105. The amount written off for depreciation of buildings and plant was £3266 and the balance of profit for the year was £10,791. Out of this amount £7500 has been paid as dividend and £2738 written off development account. The average extraction was 26·28 lb. of tin concentrate per ton, 5·38 lb. of wolfram, and 25 lb. of arsenic. These figures all show an increased extraction over the previous year, when the corresponding figures were 23·8, 5·18, and 21·3 lb. The total value of the produce per ton was 24s. 7d. and the mine cost was 19s. 5d., as compared with 22s. 2d. and 20s. 11d., respectively, in 1908. The mine has now been unwatered to the 225 fm. level and the new main shaft is nearly to that depth. When sinking is completed to that level unwatering and sinking will be continued for another 20 fm. During the year the company has completed the arsenic refining works and the arsenic output is sold well in advance. The last unit of 20 stamps out of the 60 came into operation at the beginning of the year. Other additions have been made to the plant, including another Buss table, four Frue vanners, and three slime-tables.

Botallack Mines.—A special meeting of shareholders of this company was held on February 17 for the purpose of sanctioning the proposals of the directors relating to the raising of more capital. The re-opening of this old tin mine at St. Just, Cornwall, has given much trouble during the two years since the formation of the company. There have been two managers, William Thomas and W. R. Thomas, and for the past month J. W. Teale, of Bainbridge, Seymour & Co., the consulting engineers, has had temporary charge of operations pending the appointment of another manager. The bulk of the difficulties have been due to the absence of mine records. Neither the previous owners nor the lord's estate office kept any accurate account of the workings. For instance, in sinking the new main shaft it was desired to place it in virgin ground, but when 300 ft. down it encountered old workings with all sorts of troublesome results. The affairs of the company are in an unsatisfactory state. There are 100,000 ordinary shares of £1 each and there is a large debt due to the Cornish Consolidated, one of the Allen-Meyerstein finance companies, for money advanced. Last year £4790 of income bonds were also issued. As more money is wanted the directors contemplated reconstruction and assessment, but owing to opposition in certain quarters they have propounded a scheme for the issue of 119,160 'A' shares of 5 shillings each. These will be offered pro rata to the ordinary shareholders at the rate of one 'A' share for each ordinary share. This scheme is in the nature of a voluntary instead of a compulsory assessment. The balance of 19,160 'A' shares will be offered to the holders of the income bonds in exchange for their bonds. If all shareholders do not come forward the unallotted shares will be offered elsewhere. In this way it is hoped to raise the full £25,000 required. The 'A' shares will receive out of the divisible profits each year a sum equal to 5% of the net proceeds of the tin sales together with half the remaining profits. The work requiring immediate attention at the mine is the unwatering of the Botallack section, the sinking of the new main shaft for another 700 ft., and the gradual increase of the battery from 20-stamps to 60-stamps. At the present time there is a second 20 on the spot waiting for erection, so that funds will be required for only the third 20. During most of the time the battery has been working on dump ore of low grade and the sales of concentrate have been comparatively small. It is estimated that the mine will be able to supply ore from which 40 lb. of concentrate per ton can be extracted. The eventual 60-stamps are expected to treat 70,560 tons per annum from which 1600 tons of concentrate should be obtained. If the expenses are 20s. per ton, as at South Crofty, and the price obtained £75 per ton, there will be a margin of profit amounting to £23,940. At South Crofty the Allen-Meyerstein group have pushed matters forward with intelligent energy and liberal expenditure. Although in the shadow of financial troubles, Botallack has a very good chance under the present direction and management of following the lead of South Crofty and winning its way to success.

Midas Deep. — The recent scandals in connection with the incorrect estimate of ore values and the concomitant share transactions form the chief subject of the directors' report for the 21 months ended September 1909 This mine is situated at the extreme west of the Rand, beyond the Randfontein group, and 20 miles from Johannesburg. It was originally floated in 1895 by the Consolidated Gold Fields and others ; and milling was started in 1896, but was only continued for 18 months, as the values became gradually lower. In 1904 additional property was acquired from L. Ehrlich and others. E. H. A. Cohen who had been in charge before the mine was closed in 1897 was appointed to supervise the reopening in 1908. A year ago the directors announced sensational results regarding the assays of ground recently developed. As a matter of fact the directors had received even higher figures than those published, and the chairman stated at the shareholders' meeting that some of the suppressed assays showed £7000 of gold per ton, which they had the good sense to discard. Mr. Cohen's en-



Labourers of the Rand. Chinese and Kaffirs.

gagement terminated last June and S. Roberts has been in charge since. The mill started operations at the end of March and continued until the end of September when the grade of ore was found to be too low to pay expenses. During this period 20,776 tons were milled and produced 1956 oz. gold by amalgamation, and 12,285 tons were cyanided yielding 1776 oz., a total of 3732 oz. valued at £15,698. The situation was so serious that Edward C. Homersham, of Randfontein Estates, was asked to examine and report. He found that the ' Black Reef ' on which the work had been done was narrow and of low grade. For instance at one place the lode was 3 in. wide and assaying 36 dwt. ; at another point 1 dwt. over 30 in. One of the stopes was found to average 3·3 dwt. over 30 inches, and occasionally gave samples running 90 dwt. for an inch or two. It becomes clear from this statement that Mr Cohen was able to report high assays, in spite of the fact that the average was poor and the extent of the ore limited. Mr. Homersham proceeded to make a general geological examination of the ground with the object of locating the Randfontein series, and diamond drilling has been undertaken. In the meantime the scandal connected with the inflation and collapse had received the attention of the Transvaal Government and their commissioner had made an examination of the mine ; though his report has not been published his conclusions are known to be the same as Mr. Homersham's. The directors urged the Government to make a searching investigation into the share transactions which took place while the sensational assays were being published, but the Government objected that the legal proceedings involved in such a course would be too lengthy and costly. This is a pity, for enlightenment on the subject as to who was reaping profits in this underhand manner would have been good for the mining industry.

Esmeralda Consolidated Mines.—The prospectus of this company was advertised on February 22 and following days. The company has been formed to acquire the Esmeralda, Esperanza, and adjoining silver-lead properties in the district of Iguana, Nuevo Leon, Mexico. This is a district celebrated for its silver production in days gone by ; in particular the Voladora mine, which is not far from the properties acquired by this company, was a great producer at one time. The Esperanza property contains an old mine, the Guadalupe, that once yielded well, and the present mine Cocina is also within its boundaries. The Esmeralda property has not yet been developed, but is reported to contain the same or similar lodes. The old Esperanza dumps are also said to be valuable, in fact it is stated that they contain 330,000 tons of ore averaging 20 oz. silver and 10% lead. The ore reserve in the Esperanza property is estimated at one million tons averaging 30 oz. silver and 18% lead. In addition to the lead ore there is a large amount of argentiferous zinc ores in the old Guadalupe mine. The equipment so far sent to the property is a 25-ton concentrator for the lead ores at Cocina. It is recommended that this be doubled, and that a 100-ton plant should be provided for the zinc ores at Guadalupe. The properties are 80 miles from Monterrey, so that a market for the concentrates is near-by. The report on the properties is by J. Jeffery Nicholl, who is to be mine manager for the company. His report is endorsed by R. B. Symington of San Francisco. F. W. North is consulting engineer. The capital of the company is £150,000 divided into 147,000 preferred shares of £1 each and 60,000 deferred shares of 1s. each. The preferred shares are entitled to 20% per annum and two-thirds of the remaining profits, and the deferred shares take the rest. The preferred shares are not cumulative. The promoters take £7250 in cash, £89,750 in preferred shares or cash, and the whole of the deferred shares. The prospectus offers 145,125 preferred shares for sale.

Wheal Vor.—This mine was re-opened in 1906 by the Dolcoath people. It is situated in the Breage district of Cornwall and in years gone-by was a large producer. The work of re-opening has so far been confined to unwatering and clearing the shafts and levels, and it has been delayed by the unsuitability of the electric pumps at first provided. The present report covers the financial year ended June 30 last, but the report of the consulting engineer, R. Arthur Thomas, brings the information as to developments down to the end of 1909. He reports that the present installation of electric pumps is working satisfactorily and that the mine is now unwatered to the 144 fm. level. The various levels have been explored and cleared, and some development work has been done by tributors. Tin-bearing veins have been found at a number of places ; one of these, averaging 30 lb. of black tin per ton, is receiving attention. A significant remark made by Mr. Thomas at the meeting of shareholders was this : " It is no use disguising the fact that from the examination of the workings we find that the old men have been there before." The nominal capital of the company is £90,000 divided into 120,000 ordinary shares of 10s. each and 60,000 priority shares of like value. Of these all the ordinary and 24,000 of the priority have been issued. Of the ordinary 24,000 were issued credited as fully paid in payment of the purchase of the lease and 96,000 were subscribed in cash on flotation to provide working capital. There are many overdue calls on the ordinary shares outstanding, and in the balance-sheet the calls in arrear amount to £4281. At the meeting of shareholders it was announced that about one half of this amount has been recovered and it is hoped that the eventual deficiency will not be more than £1000. The priority shares were created in June of last year when funds had run short. Of the issue of 60,000 only 24,000 were taken up, and 2s. 6d. per 10s. share has been paid upon them. At the meeting of shareholders Mr. Wethered, the chairman, announced that London brokers had signified their willingness to underwrite the remaining 36,000, if they could get any encouragement by local shareholders showing some disposition to subscribe for some of them.

Arizona Copper.—The report of this company for the year ended September 30 has been published. In our issue of September last we gave a short abstract of the half-yearly interim report. The company has its head-quarters in Edinburgh and owns the Longfellow, Humboldt, Metcalf, and Coronado mines at Clifton, Arizona, and the railway from Clifton to Hachita, where connection is made with the El Paso and South Western Railway. Robert Addie is consulting engineer and Norman Carmichael is manager. The present report shows that the amount of copper sold during the year was equal to 15,981 short tons of bessemer copper, the yield being partly in bessemer copper and partly in sulphate. The ore mined was 741,068 tons (wet), as compared with 742,959 tons the previous year. The yield from this ore was 31,573,950 lb. copper or 42·49 lb. per ton, as compared with 33,739,643 lb. or 45·5 lb. per ton. In addition 129,031 tons of limestone flux was mined. The production was distributed as follows: From the Longfellow group 59·57%, and from the Metcalf and Coronado group 40·43%. It will be seen that the yield per ton was 2·15% as compared with 2·3% the year previously. On the other hand a number of economies have recently been introduced by means of which the total yearly working expenses have been reduced from £670,508 to £616,541. In particular the adoption of oil as fuel instead of coal at Clifton and Longfellow has had a beneficial effect on expenses. The oil is pumped to the mine and plant direct from the railway. During the year 565,085 tons (dry) of sulphide ore was concentrated at the No. 6 and the Clifton plants. At the former some improvements have been made in treatment and additional machines have been added. Alterations have also been made in the arrangements for operating the plant, whereby a saving of power to the extent of 30% has been effected. The ratio of concentration is 5·8 to 1. The oxide concentrators treated 111,513 tons (dry) and the bulk of the yield was treated by leaching. For this purpose 3365 tons of acid was produced. During the current year the acid plant will be overhauled and in the meantime supplies of acid will be bought elsewhere. The total amount of ore and concentrate smelted was 142,409 dry tons and the yield of copper was 11·24%. The new briquetting plant was not completed up to time owing to the failure of the makers of certain parts to deliver according to promise. The report describes in detail the extensive development work at the various mines. Mention also is made of the fire which occurred at the smelter in January 1909, and £5000 towards meeting this damage has been transferred from the insurance fund. As regards the proposed combination of this company with other copper producers in America, the report states that the chairman was in negotiation in November with representatives of the other parties, but that the proposals were eventually postponed for the present. The business of the railway brought in a net income of £130,275. This added to the income from the sale of copper, £841,509, and other small items and the balance brought in made a total of £1,004,139 to the credit side. The expenses at the mine and in Edinburgh were £22,042, leaving a disposable balance of £365,556. Interest on debentures absorbed £8157, income tax £22,886, dividend on preference shares and stock £24,531, and £80,000 was placed to the account for capital expenditure. The sum of £189,987 is being paid on the ordinary shares, which is at the rate of 50%, and £39,994 is carried forward.

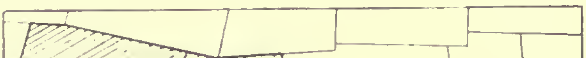
Dolcoath. — The report of the premier tin mine of Cornwall for the second half of 1909 shows, in comparison with the first half, an increase of 469 tons in the amount of ore treated and a decrease of 97 tons in the produce of concentrate. The figures were 46,349 tons of ore and 903 tons of concentrate. In our issue of September last we noted that the produce during the first half-year was 1000 tons, and mentioned that this figure had not been reached since 1901. We also recorded that during that period a smaller amount of ore of richer grade had been purposely worked in order that certain development work might be pushed forward. It was not intended that the high yield should be maintained, so the drop in the yield during the second half of the year was not unexpected. The produce was 43·68 lb. per ton, as compared with 48·85 lb. during the first half, but nevertheless it is the highest yield per ton since 1901. The average price per ton was £82. 6s. 6d. as compared with £79. 16s. 4d., and the total receipts £74,411 as compared with £79,864. Other items brought the total income for the half-year to £75,854. Against this the total cost was £63,132 including royalties of £4,960, leaving a profit of £12,722, out of which £3203 was allowed for depreciation, and £8500 distributed as dividend which is at the rate of 5% per annum on the capital £350,000. The new main shaft is now down 2832 ft. from the surface. As reported in our columns, connection was made at the 440 fm. level between the present workings and the new shaft in September last.

Brilliant Extended.—This company is incorporated in Queensland and has been operating the gold mine of that name in the Charters Towers district since 1895. The property is a deep level immediately adjoining the Brilliant & St. George. W. A. MacLeod is the manager. The present report covers the six months ended November 16 last. The mill equipment consists of 15 stamps and 5 Huntington mills, together with cyanide plant. During the period 31,500 tons was milled, producing 7045 oz. bullion by amalgamation valued at £3. 8s. 7d. per oz. or a total of £24,178; in addition 1777 tons of concentrate was produced with a value of £17. 17s. per ton or a total of £31,713; and the cyanide plant treated 20,400 tons and produced bullion worth £9203. There were other items of income arising from sale of sand and from tributors, so that the total receipts were £66,099. The recovery per long ton of ore was 44s. 8d. The cost of mining, including development, was £38,994, milling £6788, cyaniding £3873, and administration £669, a total of £50,325. The cost per long ton was therefore 33s. 6d. In looking through previous records the decrease in cost is seen to be marked. Five years ago it was as high as 53s. 4d. and the figure has been gradually reduced year by year. The ore reserve is estimated at 70,000 tons of a value rather higher than that indicated in last half-year's results, but close figures of quantity and content are not given, because in previous years it has been found that the erratic nature of the ore causes considerable discrepancy between estimates and results. The nature of the deposit also causes the cost of development to be high, the figure during the last half-year being 6s. 10d. per ton of ore mined. The profit for the half-year was £15,846, of which £12,500 has been distributed as dividend.

Le Roi No. 2.—This company was originally floated in 1900 by the late Whitaker Wright to acquire the Josie, Poorman, and other adjoining claims at Rossland, British Columbia. After the collapse of the Wright regime, the new controllers appointed Alexander Hill & Stewart as consulting engineers, and under their direction a mine that had poor prospects has continued to make profits for some years. The capital of the company is £600,000 in 120,000 shares of £5 each, a figure that was never warranted by the actual merits of the mine. Nevertheless the company has distributed £168,000 as dividends since 1904. The present report covers the year ended September 30 last. From this it appears that 60,493 tons of ore was raised during the year. This was sorted by hand-picking into 29,874 tons of shipping ore, 16,059 tons of concentrating ore, and 14,560 tons of waste. The shipping ore contained 18·9 dwt. gold, ¾ oz. silver, and 1·6% copper and the gross value was \$23·54 per ton, with silver at 52 cents per oz. and copper at 13 c. per lb. The smelting and transportation charges of this ore was \$5·70 per ton. Of the concentrating ore 15,015 tons was treated, averaging 2¼ dwt. gold, 0·178 oz. silver, and 0·527% copper. The production was 834 tons of concentrate averaging 1·55 oz. gold, 0·947 oz. silver, and 1·625% copper; and the tailing assayed 0·58 dwt. gold, 0·133 oz. silver, and 0·463% copper. The cost of crushing and concentration of this ore was \$1·16 per ton. This concentrate and the shipping ore were sent to the Trail smelter and the net amount received was £106,113. The profit made by the company after paying for mine development and allowing for depreciation was £49,384, out of which dividends absorbing £48,000 have been paid. The report on mining operations during the year presented by Alexander Hill & Stewart describes the exploration by diamond-drilling and the developments at various levels. Drilling has disclosed no new veins, but the negative results obtained have been of value in showing where to suspend the development work. It is difficult to make any dependable estimate of the reserve, as the ore is of such irregular occurrence. A careful estimate of the ore above the 900-ft. level shows that there is probably sufficient ore ready for extraction to last for 18 months. Below that level there are good chances of the orebodies developing in a satisfactory manner. The main shaft has been carried down to 1330 ft. with the object of exploring the ground in the direction where drill-holes have given favourable indications. The newer claims You Know and Surprise may also add to the life of the company.

It is noteworthy that the Le Roi No. 2 exhibits a progressive increase in profits, as remitted from the mine, with the exception of 1907, when the coal strike interfered with regular production. In 1903 the amount remitted was \$70,000; in 1905 it was \$215,000; in 1908, \$260,000; and in 1909, \$267,500.

Van Roi.—This company was formed in July 1908 to take over from the Le Roi No. 2 the Vancouver group of silver-lead mines in the Slocan district of British Columbia. Alexander Hill & Stewart are the consulting engineers. The capital is £34,500, divided into 30,000 preference shares of £1 each and 90,000 ordinary shares of 1s. each. The preference shares take one quarter of the profits and the ordinary the remainder. When £12,000 shall have been paid as dividends in any one year, the preference shares are entitled to surplus profits until they have received the sum of £30,000, after which all shares rank alike. The purchase price was £20,000 paid in cash to the local owners and 59,993 ordinary shares paid to the Le Roi No. 2. The present report covers the period from the formation of the company to September 30 last. Operations have, during this time, been mainly centred on development, and in particular the making of a drift under the hill so as to facilitate the despatch of ore to the mill on Granite creek. In driving this level two new ore-shoots were found. The concentrating plant started on April 7 and up to September 30 had treated 11,127 tons assaying 4% lead, 9% zinc, and 15·8 oz. silver, and producing 665 tons of lead concentrate and 698 tons of zinc concentrate. The former assayed 64% lead, 10% zinc, and 136 oz. silver, and the latter 44% zinc, 2·8% lead, and 30 oz. silver. The tailing assayed 0·08% lead, 6·3% zinc, and 5 oz. silver. In addition 21·68 tons of ore were hand-picked assaying 17% lead, 19·8% zinc, and 182 oz. silver. On September 30 the probable ore was estimated at 47,386 tons. The tonnage treated at the mill has been gradually increasing and at an early date the amount will be further increased from 100 to 130 tons per day. As the mill was only working for a few months during the period under review, the receipts from this source were less than the expenditure, the figures being £11,562 from sale of concentrate and £17,766 the total expenses. The outlook is good. The recent revision of tariffs in the United States has hit this company owing to the fact



that the zinc concentrate is shipped to Denver. So far there is no smelter in Canada that treats zinc on a commercial scale.

Prestea Block A.—The report of the company's engineer, Walter Broadbridge, for the year 1909 has been published in advance of the directors' report and balance sheet, in order that shareholders may have information at as early a date as possible and thoroughly understand the reasons for a proposed issue of new capital. Since the end of July, milling has been suspended and work concentrated on development and the provision of new plant. During the first seven months of the year, 49,305 tons of ore was treated, yielding 15,203 oz. in the battery, 2315 oz. in the cyanide plant, and 2009 oz. from concentrate ; a total of 19,537 oz. valued at £82,996, or 33s. 7d. per ton. The ore reserve above the fifth level on December 30 was 500,014 tons, containing 9·96 dwt. per ton. Arrangements have been completed for the provision of new machinery. Fifty new stamps are to be erected, bringing the total to 110. Electric power is being adopted and new pumps are required. The total cost of the outlay on plant will be £90,000, and a similar amount will be required for development and construction work at the mine. The company has in hand a sum of £72,000, and the directors propose to create 100,000 new shares and offer them to shareholders at 27s. 6d. per share. The whole of this issue has been underwritten by Wernher, Beit & Co., the West African Mines Ltd. (representing the Consolidated Gold Fields of South Africa), and the Fanti Consolidated and the United Exploration (both promoting companies belonging to the controllers of the Prestea Block A).

Vulcan Iron and Steel.—This company has been formed to acquire and develop the Bosshardt process for producing malleable iron and steel castings. These are produced direct without any annealing process. The British patents describing them are numbered 20,202 of 1901 and 6610 of 1909, but the prospectus states also that part of the process is secret. The capital of the company is £70,000, of which 50,000 shares of £1 each are now being offered for subscription. The vendors get £35,000, payable as to £10,000 in cash, £10,000 in shares, and £15,000 in cash or shares according to the results of the flotation. If the flotation is successful the company will be provided with £25,000 working capital. The remaining 10,000 shares are held in reserve. J. O. Arnold, professor of metallurgy at Sheffield, has examined the process, which is at work in Holland and in France, and reports favourably on its possibilities. The address of the Vulcan company is at Leeds, where the works are to be erected.

Trinidad Oilfields.—This company has been formed to acquire oil lands in the Guapo and La Brea districts of the island of Trinidad. There are three wells in operation that 'struck oil' at depths of 712 ft., 672 ft., and 520 ft., respectively. The oil is of asphaltic base and leaves little paraffin-wax residue, so that it is specially applicable as fuel. The deposits are close to the sea, and the oil will therefore be cheaply exported to the neighbouring islands in the West Indies and to parts of South America. Reports on the property and on the oil produced have been made by Thompson & Hunter, and by Sir Boverton Redwood. The prospectus of the company offers 175,000 shares of £1 each to the public. These have been underwritten at a commission of 6%, together with a call on 40,000 shares. The vendors receive £85,000 in shares and £68,000 in cash. With the working capital obtained by this flotation—approximately £100,000—it will be possible to erect plant that will produce 3000 tons per month at first and 6000 tons within two years. The cost of production will not be more than 15s. per ton and may easily be much less. The directorate is composed of solid men and the flotation has been a success.

Southern Shan States Syndicate.—This syndicate was formed a year ago to acquire the Mawchi tin properties, introduced by W. B. Dick, and situated in the southern Shan states in Burma, adjoining China and Siam. C. M. Euan Smith is the engineer in charge of the development work, and Norton Griffiths, Bruce Marriott, & Co. are the consulting engineers. The capital is £150,000, of which £74,000 in shares went as purchase price, and 14,963 shares have been issued for cash and 10s. paid on each. The directors are now issuing 20,000 more shares, having published a prospectus at the end of February. The report by Mr. Euan Smith accompanying the prospectus shows that the property is situated on the side of a steep hill. It contains a number of veins in granite and is covered with tin-bearing gravel. The latter has been prospected by means of pits, the depth of which averages 9 ft. It is estimated that there is 475,934 cu. yd. of profitable gravel ready for treatment. The content varies within wide limits, the samples giving results ranging from 2 to 91 lb. black tin per cu. yd. Three-quarters of the gravel is estimated to average 6 lb. and the other quarter 2 lb. The cost of treatment with the present resources is 4½d. per cu. yd., but by bringing a water-supply from a spot 2½ miles away the cost of sluicing could be reduced. The exploration of the underlying granite has been started at several points with successful results. The sampling of the veins shows extensive deposits of varying content, and the choice of the ground upon which to work will require the exercise of judgment. The money now being subscribed is required for the systematic development of the orebodies. In order to have independent opinion, N. B. Knox has been sent to Burma to make an examination. There are also some veins of galena on the property belonging to the syndicate ; these also will be investigated by Mr. Knox.

Champion Reef.—This is one of John Taylor & Sons' companies operating in the Kolar district, Mysore, India. It was formed in 1889 and the mine commenced production in 1892. The output gradually increased until during the year ended September 30, 1903, the output of gold was equal to £782,756, produced from 173,629 tons of ore and 206,403 tons of tailing. The next two years were similarly productive, but in 1906 signs of a poor zone began to show themselves. During the past three years ended September 30, the output has been : for 1907, £500,189 ; for 1908, £466,172 ; and for 1909, £436,097. During the three prosperous years mentioned above the dividends were at the rate of 160% on a nominal capital of £260,000 ; during the last three years they have been 40%, 20%, and 20%. The present report covers the year ended September 30. The ore crushed was 172,378 tons yielding 86,252 oz. bullion ; 253,325 tons of tailing yielded 28,732 oz. bullion ; the total yield was equal to £436,097. The profit was £118,822, out of which £52,000 has been paid as dividend, and £47,500 applied to the capital expenditure account. Recent developments are more hopeful, though there is no immediate expectation of an increase in the output. In comparing the rates of dividend in the prosperous and the later leaner years, it must be remembered that the fall is not solely due to the decreased output. The different way of debiting expenditure must also be taken into account. In the old days special expenditure and extensions of plant were not provided out of profits, but by the issue of new capital, whereas nowadays all expenses come out of revenue.

British South Africa Co.—The report of the Chartered company for the year ended March 31, 1909, is the most satisfactory and cheerful so far published. Perhaps some of the earlier reports and the proceedings at some of the shareholders' meetings in the old days were more enthusiastic, but it was the unknown possibilities that gave the buoyant feeling as compared with the more business-like gratification that rules at present. The report shows that, during the year in question, Southern Rhodesia had arrived at the self-supporting stage. The revenue was £551,789 and the expenditure £524,470. For the current year ending March 31, the revenue was estimated to be £565,560, and it was proposed to spend all this and the balance from last year. It is stated that the results are proving to be better than the estimate; that the income will reach £600,000, and that there will be a saving in the expenditure. Northeastern Rhodesia and Northwestern Rhodesia have not yet come forward, and their revenues are small. The revenue and expenditure of the former during the year were £22,446 and £49,207, respectively, and of the latter £64,195 and £86,644. During the current year the figures for the former will be much the same as a year ago, and for the latter there will be slight increases in both income and expenditure. The information contained in the report covers the subjects of mining, agriculture, labour, and administration, but as it relates to a period now long passed, and as our columns have already presented the current news from Rhodesia, we need not recapitulate here. Suffice it to say that the finances of the company have now arrived at a stage when no more capital should be required, and that the spread of railway communication has placed the country in a position for permanent settlement and expansion.

Rhodesia Abercorn Shamva Trust.—This company was formed in October last by the Rhodesia Exploration and Development group. A statement similar to a prospectus has been published this month in the advertising columns of the Press giving details of the company and its objects. The issue of shares has been underwritten and none are offered in the advertisement. The capital of the company is £450,000, of which £270,000 in shares go as purchase price; 50,000 are to be subscribed in cash, the guaranteed price being £2 per share; the remainder are to be held for future issue The company has been formed to acquire various interests, among others a 30% interest in the Shamva claims, a 30% interest in the Enterprise schist properties, and a 40% interest in the Skipper copper claims, which were located by F P. Mennell. Other property acquired consists of interests in the Cam and Motor claims, the Bell Reefs, Etna Development, and Selukwe-Columbia

British Columbia Copper.—This company owns the Mother Lode mine near Greenwood, in the Boundary district, B. C., and has a smelter of its own. It is one of the two large operators in the district, the other and larger being the Granby. The control is in New York, and J. E. McAllister is general manager. The report now issued covers the year ended November 30 last Operations were not continuous during the whole of the period, for there was an interruption from May 4 to August 8 due to the strike at the coal mines in the Crow's Nest Pass district, from which the company draws its supply of coke. During the active nine months, 338,639 tons of ore was extracted from the Mother Lode mine, 11,771 tons from the Oro Denoro mine, and 16,614 tons from the Napoleon mine. The amount smelted was 362,423 tons, together with 6964 tons of purchased ore and 3949 tons of converter slag There are three blast-furnaces, which were in operation 623 furnace-days, and the tonnage per day, excluding coke, was 599 tons per furnace. The production of blister copper from the company's and from purchased ore was 6,366,318 lb., containing 6,325,000 lb. fine copper, 18,244 oz. gold and 64,234 oz. silver. The average price received for the copper was 13·08 c.; the cost per ton of copper 9·83 c.; and the cost per ton of ore $2·68. The net profit was $204,973. Paul S. Couldrey, manager of the Mother Lode mine, reports that the development continues to add to the ore reserve. During the year, the company has acquired a controlling interest in the re-organized Dominion Copper Co., which owns mines adjacent. The ore-supply for the furnaces will be accordingly increased, and the capacity of the plant is to be augmented.

Selukwe Gold.—In our issue of October last we gave an abstract of this company's report for the year ended March 31, 1909. This report showed that the mine was yielding less than formerly, and that the cost was greater than the production; in fact the losses during the last year and the two years before amounted to over £70,000. It was made oovious that the condition of the company was serious. The directors had tried to obtain additional property of value and had acquired the adjoining 'Nigger Reef,' but this is proving to be equally unsatisfactory. The position of the company being critical, the directors decided to get further advice. A. H. Ackermann, engineer for the British South Africa Company, which holds a share in Selukwe, reported that though Nigger Reef did not hold out any immediate hope of saving the company, yet the lowest levels gave indications of a hopeful nature. He therefore recommended the expenditure of £15,000 on development. There are forty stamps, together with a cyanide plant, and during the year ended March 31, 1909, the total yield was 14,881 oz. from 61,392 tons of ore, a production of 5 3 dwt. The cost of mining and extraction was about equal to the production, but the costs of development and depreciation were equal to another 2½ dwt. per ton. At a meeting of shareholders held at the beginning of this month, a reconstruction plan recommended by the directors was adopted. A new company is to be formed with a capital of £150,000 in 600,000 shares of 5s. each. Of these 321,000 are to be given to the shareholders in the present company in exchange for their shares, one 5s. share being given for each £1 share. Of the remainder 100,000 shares are to be offered for subscription to present shareholders, and 50,000 are left on call at par to such subscribers.

Dharwar Reefs.—In our November issue we recorded that this mine, in the Bombay presidency of India, and managed by John Taylor & Sons, was in a serious condition. The expectations had not been fulfilled with regard to the quality of the ore, and difficulties in connection with cyanide extraction had been caused by the presence of graphite in the ore. The directors have this month issued a circular to shareholders announcing that the superintendent, James Roberts, has reported favourably on discoveries recently made and has recommended further development work. It is therefore proposed to raise additional capital by means of a reconstruction. The new company is to be called the Kabulgitti Gold Mines Limited. The capital will be £98,700, divided into 400,000 preference shares of 2s. each, entitled to a non-cumulative dividend of 25%, which are to be offered for subscription among shareholders, and 234,800 ordinary shares of 5s. each, which will be given to holders of £1 shares in the present company in exchange for their present holdings.

BOOKS REVIEWED

THE MINING MANUAL, 1910.—By Walter R. Skinner. Cloth, octavo. 1550 pages. London: Walter R. Skinner. Price 15s. For sale by *The Mining Magazine*.

It is twenty-four years since the first issue of this publication appeared, and by this time everybody interested in the finance of mining and the doings of mining companies ought to have learnt to appreciate its usefulness. The book gives information about all the mining companies registered in the United Kingdom and as far as possible about foreign companies whose shares are known on the London market. When the book was first published, it simply gave particulars of the capitalization, the officers, and the situation of the properties, but since then the scope of the information given has greatly extended. For instance, the dividends from the inception of each company are recorded, and the last balance-sheet is analysed; also the nature of the plant is described and figures relating to ore reserves and exploring work are recorded. In connection with finance companies the holdings are quoted whenever possible. The author in the preface to the current volume draws attention to the difficulty of obtaining details of the doings of new companies that do not issue prospectuses, and he gives voice to an expression of regret that the Company Act of 1908 is already being virtually evaded by certain promoters. He also complains that many balance-sheets contain no information whatever. I would add that in quite a number of cases the balance-sheet appears to be drawn up with the express intention of concealing the actual position of the company, and it is a pity that the standard system of keeping accounts makes it possible to evade the truth in this way. I have used Skinner's Mining Manual continuously and day by day for many years, and probably few have used it more. I can say truthfully that I have always found the information up-to-date, accurate, and complete.

E. W.

RECORDS OF THE LONDON AND WEST - COUNTRY CHAMBER OF MINES. Vol. III., part 5. Paper covers. 38 pages. London: The Chamber, 38 Finsbury Pavement, E.C. Price 1s.

These records appear every quarter, and form the only publication devoted entirely to giving reliable information relating to Cornish mining in a handy form. News from Cornwall of course appears in various daily, weekly, and monthly papers, which are followed by those more intimately interested in the west country, but there must be many Cornishmen abroad who would like to keep in touch with the doings at home and to these we commend the Records.

It may be taken for granted that many Cornishmen abroad are doing pretty well, better in fact than if they had stayed at home. They will therefore not grudge a subscription to the London & West Country Chamber of Mines, which is doing excellent work for the mining interests of the county. The credit for the vitality of the Chamber is due to J. H. Collins, and to H. E. Fern, the secretary. The problems of tin mining and extraction are ever present. In times gone by, the mines paid for themselves because the surface ores were 'kindly.' Re-opening, deep sinking, and better extraction of leaner and more complex ores now afford different problems. In other parts of the world new mines as well as old mines present just as difficult problems, and the engineers and capitalists find no difficulty in meeting them successfully. Interchange of discussion, and collaboration in connection with trials and investigations relating to mining and metallurgical methods, have been of infinite service in mining centres such as Johannesburg and Kalgoorlie. There is no such centre of discussion in Cornwall, yet this Chamber provides the opportunity, and was indeed intended for the special purpose. Why is it that mine managers forget the necessity for solidarity, and are content to pursue their everyday tasks in a spirit of fatalism? There are of course worthy exceptions in the way of individual managers and investigators. It is a pity that the others do not follow the modern lead, and so enable the industry generally to collaborate on a mutual basis.

ELEMENTARY TEXT-BOOK OF COAL-MINING. Fourteenth edition. By Robert Peel. Cloth, small 8vo. 370 pages. Ill. London: Blackie & Son. Price 2s. 6d.

This has been a successful class-book for elementary students preparing for the Board of Education examination in the principles of mining and for colliery managers' examinations. The succeeding editions always contain something new and thus the book is kept up to date. The descriptions are clear, and local terms are used in such a way that their meaning is made obvious to the non-technical reader. There is also a glossary at the end. We mention this because in reviewing another English book on coal mining, an American contemporary remarked that it was quite useless to anyone outside the British coalfields owing to its parochial terminology.

JOURNAL OF THE INSTITUTE OF METALS. Vol. II. 1909. Edited by G. Shaw Scott, Secretary. Cloth 8vo. 250 pages. Ill. London: The Institute of Metals, Caxton House, S.W. Price one guinea.

The second volume of the transactions of the Institute includes the papers read at the meeting held at Manchester in October last. These papers discuss the following subjects: Aluminium-copper-tin alloys; surface appearance of solders; causes of corrosion of copper and brass; study of copper-zinc alloys; elastic breakdown of non-ferrous metals; production of zinc by the Brand process; welding of aluminium; and the technical assay of zinc.

These volumes are to be published half-yearly and we recommend that members and others should peruse them carefully, instead of relying on each paper as presented at the meetings and such outline of the discussion that may appear in the current Press. There is a vast amount of additional information in the volume, in the way of full reports of the discussion, written contributions, and authors' replies and addenda. The Institute does not get quite satisfactory treatment by the reporters that attend the meetings on behalf of the Press. It is no matter of surprise that this should be so, for the subjects are highly specialized, and a reporter, even though well versed in general technology, finds it difficult to do justice to the discussion. It is a pity that the Institute's volumes cannot be published at an earlier date after the meetings, for interest in the discussions is apt to drag. The American Institute of Mining Engineers, which holds two meetings a year on the same plan as the Institute of Metals, found it the best policy to issue a monthly bulletin so as to keep the publication of papers and the discussions upon them up to date. This method has the additional advantage of making it possible to distribute some of the papers in advance of the meetings at which they are to be read and thus give members more preparation for the discussion. A new feature introduced in the current volume are the pages devoted to short abstracts and notices of papers relating to the non-ferrous metals that have appeared in the Press and in the transactions of other societies.

TECHNICAL DICTIONARY OF TERMS RELATING TO HOISTING AND CONVEYING MACHINERY. By A. Schlomann and P. Stulpnagel. Cloth, small 8vo., 660 pages. Ill. London : Constable & Co. Price 10s. 6d.

This forms the seventh volume of the Deinardt-Schlomann series of technical dictionaries, which give the equivalent words, expressions, and sentences in six languages, German, English, Russian, Italian, French, and Spanish. Wherever possible an outline illustration in miniature of the machine or mechanism is given. The subjects covered in the present volume are : statics and dynamics, lifting machinery, cranes, lifts, conveyors, ropeways, driving gear, structural iron and steel. The book is prepared in Germany, from a German standpoint, but it gives translations into and out of all the six languages. The definitions and nomenclature have been revised in each country. As far as the English revision is concerned we regret that practical men of wide experience have not had a say in matters ; if such had been the case the English would not have had such a strong German flavour. For instance, 'iron constructions' is not, as the well-known poster has it, 'quite English, you know.'

ORE AND STONE MINING. By Sir C. Le Neve Foster. Seventh Edition, revised by S. Herbert Cox. Cloth 8vo. 830 pages. Ill. London : Charles Griffin & Co. Price 28s.

The new edition of this well-known book does not contain any notable additions, but a paragraph in the preface attracts our attention. Professor Cox says that the "scope of the work may be extended in a future edition, as the business acumen that is now brought to bear upon mining and the publicity that is given to new methods of working claim attention in such a treatise." We shall look forward with interest to this future edition. In connection with the present edition we are glad that the publishers now issue the book at a net price.

NEW PUBLICATIONS

FUEL AND REFRACTORY MATERIALS. Second edition, revised. By A. Humboldt Sexton. Cloth, 8vo. 370 pages. Ill. London : Blackie & Son. Price 5s.

This book is used in the metallurgical course at the Glasgow and West of Scotland Technical College. It gives an outline of various fuels, solid, liquid, and gaseous, heating power, coal-washing, coking, recovery of by-products, furnaces for metallurgical purposes, pyrometry, calorimetry, etc. The new edition contains additional information relating to coke-ovens, gas-producers, and pyrometry.

TRANSACTIONS OF THE AUSTRALASIAN INSTITUTE OF MINING ENGINEERS. Vol. XIII., 1909. Octavo. 215 pages. Ill. Published by the Institute at their Melbourne office.

There are many admirable papers in this volume of Transactions. Richard Hamilton's address on progress in mining in Western Australia covers a large field and his remarks relating to exploration by diamond drilling are of interest. Wainwright and McBride give a paper on comparative tests of fine grinding by tube-mills and wheeler-pans used on Broken Hill ores. Of other papers we may mention those by J. M. Bell on the economic geology of New Zealand, by Harry Adams on the disposal of residues at Kalgoorlie, and by A. Montgomery on some geological considerations affecting Western Australian ore deposits. The Institute recently established branches at several leading centres of activity, a policy which will help to encourage discussion.

THE YUKON TERRITORY : ITS HISTORY AND RESOURCES.—Paper covers, octavo. 140 pages. Ill. Ottawa : The Government Printing Bureau.

This official pamphlet published by the Canadian Government gives a historical account of the development of the Yukon and describes the present condition of mining and other industries in that province.

A DESCRIPTIVE SKETCH OF THE GEOLOGY AND ECONOMIC MINERALS OF CANADA. — By G. A. Young. Octavo. 150 pages. Ill. Ottawa : The Department of Mines.

This book gives a brief account of the general geological features of Canada, and of the minerals that have assumed economic importance. For some years the various writings of George M. Dawson, late director of the Geological survey of Canada, supplied the public with this class of information. As these are now out of print, and as the demand still continues, the present book has been prepared.

NEW CATALOGUES

RICHARD PAPE, LIMITED, of Belvedere, Kent, has issued a new catalogue relating to the Fors accumulator. One of the applications is the miner's safety lamp. The accumulator is made with cylindrical plates, which give extra strength.

GEBAUER WORKS & ENGINEERING CO., of Berlin, represented in London by H. F. Crohn & Co,, publishes a catalogue describing haulage-plant and turbine and plunger pumps.

CROMPTON & CO., of Chelmsford and London, send a copy of a new list dealing with electrical plant for mines, including winding-engines, pumps, air-compressors, ventilating-fans, etc. This firm has recently supplied plant to Dolcoath, the Premier diamond mine, and the Crown mines.

THE NEW YORK ENGINEERING CO., designers and builders of gold-dredge machinery, have published a pamphlet describing the Empire hand-prospecting-drills used in testing gravel deposits ; also a general catalogue describing the construction of dredges and their power equipment.

KILKER'S PATENT MATTE-TAPPING CAR is described and illustrated in a pamphlet issued by the Pacific Foundry Co., San Francisco. Fraser & Chalmers are the London agents for this plant.

AERIAL ROPEWAYS on the system of Ceretti & Tanfani, of Milan, are described in detail in a catalogue sent by T. L. Cunningham, their London agent. The illustrations of the application of the system and of typical installations are unusually good.

JOHN DAVIS & SON, Derby, send lists of theodolites, dials, aneroids, drawing instruments, and other apparatus used in connection with mining.

BORAX GLASS.—Borax Consolidated Limited has issued a pamphlet relating to their new 'Twenty-Car' brand of borax glass. This material is borax that has been fused in order to remove the water of crystallization, then ground to a powder, and packed in sealed tins. For the purpose of refining bullion it is desirable that it should be as free as possible from impurities. The 'Twenty-Car' brand has been introduced for this purpose. It is guaranteed 99% anhydrous biborate of soda, free from metallic oxides, and containing not more than 0·5% water, 0·5% insoluble matter, 0·1% sodium chloride, or 0·1% sodium sulphate.

CURRENT LITERATURE

Gold Mining in Hungary.—In the *Mining and Scientific Press* for January 1, Newton B. Knox gives an account of gold mining in Transylvania, and more particularly of the mines at Boicza.

Metallurgy in Colorado.—In the *Mining and Scientific Press* for January 1, P. H. Argall contributes an article on metallurgical progress in Colorado during 1909.

Chile Nitrate.—In the *Mining and Scientific Press* for January 15, S. H. Loram gives the first instalment of a series of articles on the nitrate of soda industry of Chile.

Coarse Crushing at Boston Consolidated.—In the *Mining and Scientific Press* for January 15, L. S. Austin gives details and drawings of the coarse crushing plant at the mill of the Boston Consolidated at Garfield, Utah.

Precious Metals in Colorado.—In the *Mining and Scientific Press* for January 8, T. A. Rickard gives the first instalment of an article on the geological distribution of the precious metals in Colorado.

Review of Analytical Chemistry.—In the *Western Chemist and Metallurgist* for January and February, V. H. Gottschalk gives a review of papers and articles published during 1909 relating to improvements in methods of analysis and assaying.

Shaft Linings.—In the *Iron and Coal Trades Review* for February 11, the system of lining shafts by means of segmental blocks of concrete is described. This system is the invention of Charles Walker, of Wrexham, and is employed at the Welsh Coal & Cannel Co.'s pits. The blocks are grooved in such a way that the joints can be thoroughly cemented, and the process of building in place does not interfere with the sinking operations.

Mexican Mining Law.—The *Mexican Mining Journal* for February and March gives the full text of the new Mexican Mining law.

Iron Hill, Leadville.—In the *Engineering and Mining Journal* for Janmary 29, George Oates Argall describes the lead deposits at Iron Hill, two miles from Leadville. This district was worked for lead carbonate in former days, and recently attention has been directed to the sulphide ore. The author is manager of a company operating at Iron Hill and he presents the latest information as to the structure and nature of the ore deposits as exemplified by the workings at his mine. The earlier researches tended to show that the ore was confined to the Carboniferous limestone, but Mr. Argall describes the occurrence of galena and other sulphides in the Silurian limestone and in the Cambrian quartzite.

Heavy Stamps.—W. A. Caldecott's paper on this subject recently read before the Institution of Mining & Metallurgy has also been discussed by members of the Chemical, Metallurgical, & Mining Society of South Africa. C. O. Schmitt has contributed a discussion describing several details in connection with modifications in the structure of stamp-mills introduced on the Rand.

Cyanide Practice in Nevada.—In the *Engineering and Mining Journal* for January 22, P. E. Van Saun describes the cyanide plant at the Montgomery-Shoshone mine at Rhyolite, Nevada. The plant started in 1907 and treats 6000 tons per month of silver ore containing some gold and valued at from 10 to 12 dollars per ton. No amalgamation is done. Crushing is done by rolls and the oversize is then re-ground by Chilean mills. The crushed ore is then separated into slime and sand, and each product sent to concentrators for the removal of pyrite, the slime to Frue-vanners, and the sand to Wilfleys. The slime and sand are then treated separately in cyanide apparatus, and the pyrite concentrate is sent to a tube-mill in which cyanide solution is used and afterward to cyanide vats. The recovery of precious metal from the pyrite is as high as 99 per cent.

Keedy Ore-Sizer.—In the *Engineering and Mining Journal* for February 5, D. V. Keedy describes his dry sizer, which was designed for the purpose of producing better concentration of complex minerals containing zinc. It was used in connection with the Sutton dry table.

Endless Rope Haulage.—At the December meeting of the Chemical, Metallurgical, and Mining Society of South Africa, H. G. Kay read a paper on endless rope haulage as applied to the disposal of tailing and other refuse. He described in particular the method used at the Premier Diamond Mine. He gave particulars of the method for attaching the cars to the wire rope and for automatically disengaging them at their journey's end; also of the apparatus used for automatically tipping the cars and for subsequently righting them.

Estimation of Copper in Slag.—In the *Engineering and Mining Journal* for February 5, C. A Heberlein gives a method of determining small quantities of copper in slag containing much iron.

Florence-Goldfield Mill.—In the *Engineering and Mining Journal* for February 12, H. G. Morris describes the metallurgical plant of the Florence mine, at Goldfield, Nevada. Some of the gold is free and some is associated with pyrite and other sulphides. Small amounts of silver are also present. The practice is (1) to crush in stamps and amalgamate; (2) to remove the sulphides on Card tables; (3) to re-crush the tailing in tube-mills; (4) to pass it over a second series of amalgamation-plates; (5) to send it to Deister tables and Frue vanners to further remove sulphides; (6) to treat the tailing by the cyanide process. At one time Brussels carpet was used instead of the first and second series of amalgamation-plates, but was subsequently abandoned.

Premier Diamond Mine.—In the *Engineering and Mining Journal* for February 12, E. M. Weston gives an illustrated account of the Premier diamond mine in the Transvaal.

Nitrate in Chile.—In the *Mining and Scientific Press* for January 22 and 29, S. H. Loram gives an account of the nitrate fields of Chile and of the methods adopted for extracting the nitrate.

Smelting in Colorado.—In the *Mining and Scientific Press* for February 12, H. Foster Bain gives an account of the present position of smelting in the district round Denver, more particularly going into details relating to the Modern Smelting Co.'s plant.

Gold Dredging in the Philippines.—In the *Mining and Scientific Press* for February 12, a correspondent gives particulars of gold dredging operations on the Paracale river, in the Philippine Islands.

Cyanide Slags.—In the *Mining and Scientific Press* for February 5, J. D. Hubbard describes a small blast-furnace used for smelting cyanide-slags produced at the plant of the Oriental Consolidated Mining Co. of Taracol, Korea.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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CONTENTS.

REVIEW OF MINING

INTRODUCTORY.—The House of Lords divides attention with the rubber market. The bear attack on the first is matched in vehemence by the bull campaign in the second. At the close of the month Paris and Amsterdam have had lively dealings in rubber shares and we almost fear to think of the frenzy into which the present speculative excitement may develop should New York awaken to this new opportunity for making money swiftly. Rubber and oil continue to have their innings, but gold-mining shares are not neglected. London is enjoying the speculative enthusiasm; we are informed that the mid-March settlement on the Stock Exchange was the biggest on record; indeed, it was so enormous as to have been prolonged over several days. Incidentally, we note that several firms known in connection with mining are engaging in rubber flotations; the Venture Corporation, under its reconstructed title of the London Venture Corporation, having made several successful rubber issues. L. Hirsch & Co. also have participated. But mining finance has not suffered as yet from the attention given elsewhere. The boom in the shares of rubber companies must abate shortly, for it is being overdone. A soaring price for the product is incompatible with the wholesale organization of companies to produce a substance the need for which is inciting chemical research to find a cheap substitute. The increased price of golf-balls should stimulate the motherly invention that protects necessity.

The rubber boom exceeds in violence even the Kaffir excitement of 15 years ago. Unless the brake is put on shortly the continuous issue of new stocks will exhaust the supply of capital and precipitate a colossal crash. According to *The Economist* the applications for capital made during the first three months of 1910 aggregate nearly £100,000,000, as compared to 64 millions in the corresponding period of 1909, and 45 millions in 1908. The actual figure, £99,355,600, is the largest recorded for any single quarter of a year. Even during the Boer war the total amount was only £83,000,000, of which fully £60,000,000 was due to the requirements of the Government. These applications for fresh capital are distributed over a wide extent of financial enterprise and reflect a venturesome spirit in every form of industrial activity. The course of the stock markets in the near future must depend largely on the Bank rate. The reserves of the Bank of England are 15½ million pounds lower than a year ago and unless this adverse balance is corrected by imports of gold from New York, the money rate will rise sharply. A 5% rate would be a damper on speculation, although it is noteworthy that the increasing number of deals for special settlement tends to lessen the borrowing of money.

SOUTH AFRICA.—Activity in Kaffir shares was not apparent until the close of the month, although early in March the shares of General Mining were in demand, more particularly in Germany, on account of the encouraging character of the annual report, accompanied by an increase of dividends from 5% to 15% for the 12 months. In the middle of March the issue of Modder State Mines was made most successfully, the quotation going at once to a big premium. Modderfontein B are also better on reports of rapid development, it being announced that by December the ore developed will amount to 2,000,000 tons. Consolidated Goldfields have added more than a million pounds to their market valuation in anticipation of the flotation of a company to operate the Shamva claims in the Abercorn district. The February profits of the Witwatersrand mines are stated to have been £900,269. An increase is expected for March and April.

A good effect was made by the speech of Mr. Raymond Schumacher when presiding at the meeting of Rand Mines Ltd. He acknowledged that operations during the latter part of 1909 were hampered by shortage of labour, but he claimed that prospects for an adequate supply are much brighter now. In February 184,869 natives were employed in the gold mines of the Transvaal, this being the highest figure recorded. In March the number was augmented to 199,549. Expansion in development was promised, but Mr. Schumacher laid no stress on the increased demand for labour created thereby. It is true that the number of natives employed is increasing but not commensurately with the ambitious enterprise of the mine operators; hence, when the annual migration of Kaffirs to their farms depletes the labour supply, we shall see a repetition of the disappointment and anxiety that depressed the share-market in the latter half of 1909. In regard to technical progress the chairman of Rand Mines referred to the success of the scheme for filling old workings with the tailing from the mills. This method of ensuring the safety of the mines, avoiding the necessity for pillars, and regulating ventilation underground, has been successfully applied at the Robinson by Mr. W. W. Mein, and promises to be a useful adaptation of a method borrowed from Upper Silesia. At the meeting of the Robinson, also held at Johannesburg, it is reported that a director suggested working the richer ore first and "inaugurating a period of high dividends." The cablegram does not say how the suggestion was received but we have a decided opinion how it ought to have been received. Proposals such as this, and the one to issue annual instead of monthly reports, indicate a spirit of insolent irresponsibility that needs to be checked whenever manifested. Of course, the logical tendency is all the other way, namely, to reduce the grade of ore to the minimum yielding a reasonable profit and to avoid the selecting of ore. The economic ideal looks equally to the present profit and the future life of a mining enterprise.

RHODESIA.—According to telegrams from Salisbury, a new goldfield has been uncovered at Marandellas. The Abercorn district just now is blossoming into several new companies: the Rhodesian Gold Trust is about to float one, which is the sequel of the Shamva Trust, issued a month ago. Rhodesia Copper has recently put out a subsidiary called the Bwana M'Kubwa and Mr. Abe Bailey is preparing the Enterprise Schist. These issues mark the increased public interest in Rhodesian mines, but the Dwarf, another new company, serves best to indicate the belief that the public is ready to swallow any bait, for the prospectus of that company gives wholly inadequate information. The rise in Surprise shares has continued on the belief that a big orebody has been uncovered and the reports from the Eldorado give assays indicating extraordinarily rich ore. These facts justify the increased confidence in Rhodesian mining, but they do not warrant the high prices to which many shares have been forced. Good news is over-discounted. Take Globe & Phœnix for example: here the reserve has been increased from 144,348 tons of 16 dwt. ore at the end of 1908 to 171,507 tons of 31·23 dwt. ore at the end of 1909. This is a result of which the engineer, Mr. H. A. Piper, may well be proud. But at the present time the ore being milled is above the average grade, in order to compensate for the decreased capacity of the mill, which is being remodeled. To warrant the increased valuation of the mine, as indicated by quotations, it will be necessary to find more ore as rich as that now being extracted. All depends on the showing at the 17th level, for that will prove whether the improvement below the fault is to be persistent or only local.

As we go to press, on April 7, the prospectus of the Shamva Mines is issued "for public information only." But even this phrase fails to express the fact, for the data are not as informing as they ought to be. The capital is divided into 600,000 shares of £1 each, which were introduced on the market at a premium of $2\frac{1}{4}$, at which price, accepting the estimate of a profit of £90,000 per annum, the yield to investors is only $4\frac{1}{2}$%. The report on the mine is a most disingenuous document, for estimates are expressed in terms that are elusive even to those best able to understand such information. We have no space to discuss the matter now, but intend to do so in our next issue. We regret that an engineer of high repute and a company of acknowledged respectability should be responsible for an issue the manner of which is open to such obvious criticism.

WEST AFRICA.—The Ashanti Goldfields has declared a dividend and Bibiani have risen on rumours of a railway, but on the whole this department has been quiet. Earlier in the month the Abbontiakoon announced the cutting of 4 ft. of 2 oz. ore on the 1800 ft. level. The chief activity has been in the vicinity of the territory controlled by the Wallis Syndicate, in which the Consolidated Mines Selection Co. has taken an interest for its subsidiary, the West African Mines Selection. Mr. F. F. Sharpless is inspecting these banket deposits. Several other engineers of high standing are now in this part of West Africa and should their reports coincide favourably it may be expected that increased activity will ensue.

AUSTRALIA.—With the ending of the coal strike it is evident that industrial conditions in the island continent are excellent. The revenues of the Commonwealth are growing satisfactorily. In New South Wales excellent prices for a large wool-clip and a record wheat harvest have brought general prosperity. Banking returns show that in the Commonwealth of Australia and the Dominion of New Zealand the deposits amount to £142,000,000, which does not include those in Savings Banks. The Broken Hill mines have declared satisfactory dividends despite the higher costs due to the strike. A fuss over the use of lithofracteur supplied by the Cape Explosives Co. has accentuated the effort to avoid the Nobel combine. Our Melbourne correspondent sends an interesting budget of news.

The creation of an exploration company to take over such assets of the Oroya Brownhill company as are not held by the recently consolidated Oroya Links and Oroya Leonesa companies, is another step in the perpetuation of good-will and organization, both of which can be usefully applied to new ventures. It is true that a shareholder objected to the distribution of the assets of the old company among three new companies, but the chairman, Mr. G. P. Doolette, explained that this procedure was necessary to avoid legal complications arising in case a single dissatisfied shareholder should invoke the aid of the courts. For ourselves, we deem the perpetuation of company organization an economic development well worthy of encouragement. It takes time to collect a staff and to select men in whom confidence can be placed, both for operating and inspecting mines. Moreover, if directors take pains to protect the shareholders, it is possible to eliminate promotion expenses and middlemen's profits by acquiring new mines direct on the advice of the old company's engineers. The Oroya Brownhill appears to have done well, for when the old bonanza at Kalgoorlie proved to be nearing exhaustion, the Leonesa mine in Nicaragua was acquired, besides the Youanme, Black Range, and other promising prospects in Western Australia. Of course, the perpetuation of a company gives continuity of control to a board of directors and if several subsidiary companies are formed these directors receive additional fees, but such emoluments are well earned if the duties are properly discharged. Shareholders should be less anxious as to a director's fee, and more particular as to his devotion to their interests.

From MEXICO we still hear echoes of the Santa Gertrudis Camp Bird deal. We note with much regret the death of Thomas F. Walsh, who developed the Camp Bird into one of the great mines of the world. The El Oro mines continue to find favour among French speculators, who have forced Dos Estrellas to a price on which it pays 3% only. Also the Mexico shares have been 'boomed' to an excessive extent and are now at a price deprecated even by the friends of that mining company. We learn that the Exploration Co. has taken working options on two properties in the Santa Eulalia district of Chihuahua, but local statements as to the purchase of mines are premature. Attention is being directed to the Hostotipaquillo district, near Guadalajara, Mexico. This district boasts two notable mines, the El Favor and Cinco Minas, both of which are old mines that have been resuscitated successfully. The lodes are large, and exhibit the sort of complex faulting that creates conditions favourable to secondary enrichment.

UNITED STATES.—Impending labour troubles and anticipations of Supreme Court decisions unfavourable to the trusts have depressed the New York stock-markets. The re-appearance of Mr. Roosevelt on the political horizon is sure to strengthen the reform party in America and will put new heart into the efforts to break the power of monopoly, and of the tariff on which monopolies are fed. The check given to the Speaker of the House of Representatives is an event of world-wide interest, for Mr. Cannon, by his autocratic control of legislation, has had greater power even than the Presidents. He has been the right hand of the alliance between strategic finance and piratical politics.

Our New York correspondent refers to the Anaconda merger, and we note that Amalgamated Copper has recently been listed on the Stock Exchange; this step necessitated the filing of a statement, from which it appears that the Amalgamated owns half of the Anaconda, and all of the Boston & Montana, Butte & Boston, and Parrot, and other Butte mines, together with 100,000 shares (out of 2,500,000) of Greene-Cananea and 50,000 shares (out of 1,000,000) in Butte-Coalition. Its production last year was 130,313 long tons of copper, together with 9,837,265 oz. silver and 59,074 oz. gold. The net income was 2·13% on the $53,887,900 of capital stock.

While the Yukon Gold Co. has not justified the roseate expectations of its sponsors, it is pleasing to note that the technical work at the mines near Dawson has come up to anticipations. During the past season the dredges handled 2,381,880 cubic yards for a yield of $1,363,722, which is equivalent to a yield in gold of 57 cents per yard. The average cost was 32 cents per cubic yard, inclusive of 15½ cents for thawing and $2000 per month allowed for depreciation on each dredge. The hydraulic mines were only operated 23 days out of the season of 142 days.

The Goldfield Consolidated continues to open up satisfactorily in the bottom workings, the 1000 ft. level Clermont shaft having been advanced in $45 ore. On the 600 ft. level the ore is 15 ft. wide for 170 ft. and averages 6 oz. gold per ton. In February the production was 23,866 tons, worth $725,000, from which a profit of $480,000 is estimated.

Renewed activity in the promotion of companies to operate in the copper region of Lake Superior will attract attention to the premier copper mine of the world, the Calumet & Hecla. This company was organized in 1871 with a capital of $2,500,000 in 100,000 shares of $25 each. Only $12 per share was called up, for no more money was needed. Thus on an original assessment of $1,200,000 the mine has paid not less than $113,500,000 in dividends. The shares issued at $25, and on which $12 was paid, have sold as high as $1000, and are now quoted at $600. In later years the company has adopted the policy of acquiring interests in neighbouring mines; these purchases have accumulated until they represent an immense holding, likely to become of increasing value and tending to offset the exhaustion of the parent mine, which on its dip is cut off by the Tamarack. In July 1909 the Calumet & Hecla company owned 601,152 shares in 15 other Michigan copper companies, representing an average of 49% of the stock of those companies. These shares are estimated to be worth now between $20,000,000 and $25,000,000. This explains the decrease in Calumet & Hecla dividends, for the profits have been partly expended in acquiring these outside interests. Last year the dividends aggregated $20, but the year before they were $50 per share. The production of copper in 1909 was 82,8162,30 pounds, an increase of 3,835,764 over the year preceding. Elsewhere we refer to the death of Alexander Agassiz, the president of this company.

CANADA.—Our Toronto correspondent states that the rush to the Porcupine district has been sobered by knowledge of the fact that the ore is low-grade and cannot be benefitiated until large mills are built; and that in turn must await upon systematic development underground. Meanwhile another goldfield is reported as having been found near Fort Matachewan and also around Separation lake. No genuine prospecting is practicable until the snow melts in the spring, but the 'stampedes' of the winter ought to be precursors of some valuable finds among the many reported.

The preliminary report on the mineral production of Canada has been issued by the Division of Mineral Resources and Statistics. An increase of 5% in the gross output is shown, namely, from $85,927,802 in 1908 to $90,475,763 in 1909. The total is almost equally divided between metallic and non-metallic products.

RUSSIA.—Among Siberian mines we note that the Kyshtim is steadily increasing its production, from 129 tons of blister copper in October last to 162 tons in February. And the cost is being lessened; it was £44 per ton in October and £36 in February. The erection of the new smelting plant is making good progress. A depth of 445 ft. has been attained in the main shaft and developments are satisfactory.

At the Spassky the production of copper fell in February to 80 tons, but this decrease was due entirely to the fact that the reservoir froze to the bottom, owing to the combined effect of extreme cold and silting. This has been remedied. The output should now average 190 to 200 tons per month. The 420 ft. level has exposed 30 ft. of ore assaying over 30% copper, not including the ore on the hanging wall. Operations are held back pending the arrival of a duplicate blower.

Copper production in Russia is increasing slowly; during 1909 the output was 18,100 tons as against 16,480 tons in 1908. The Ural contributed 8530 tons, the Caucasus 630, the Altai 48, and Siberia 2400.

The Lena Goldfields publishes weekly reports recording the production, which continues on a large scale. The gravel yields more than half an ounce of gold per cubic yard, the weekly return showing 20,000 yards for £40,000 worth of gold. Already the output for the financial year, from October 1, amounts to £670,948. But why is the yield based on 'development assays'; surely this is a peculiar technical term, if it refers, as we understand, to the daily tests made by panning gravel taken from the faces of the workings, as the ground is removed?

SOUTH AMERICA.—There is reason to believe that productive goldfields are being developed in the Lavras and San Gabriel districts, in the province of Rio Grande do Sul, in Brazil. An area of 100 square miles is reported to be richly gold-bearing. Natives have worked the alluvial deposits by crude methods and now an English company, the Brazilian Goldfields, has undertaken systematic operation on a freehold of 24 acres. The district is reached from the port of Rio Grande by a railway journey 200 miles long to San Sebastio, from which town a good wagon-road leads to Lavras. Freight is £2. 10s. per ton from the coast. André P. Griffiths is consulting engineer to the company mentioned. Other concerns in this region are the Brazilian Gold Hill and the Brazilian Development Syndicate, with which T. H. V. Bower and R. S. Botsford are respectively connected. At Matto Feio another London syndicate is operating under the direction of W. Hildred. A new discovery called the Eldorado is being opened up by G. F. Heath, while A. E. Thomas is in charge of the Golden Hill. These mines expose narrow veins, 1 to 2 ft. wide, of ore ranging from 15 dwt. to 2 oz. gold per ton, and the ore-shoots are stated to be several hundred feet long. An energetic group of technical men is engaged in this exploitation, so that decisive results may be expected.

A cablegram announces that the first train has passed through the Andes between Chili and the Argentine. The railway will soon be open to public traffic and should stimulate industry. The journey from Buenos Ayres to Valparaiso can be made in 30 hours.

Copper.—The table of statistics issued by Henry R. Merton & Co. exhibits the enormous growth and striking vicissitudes of the copper trade during the last twenty years. Prices for the metal have ranged from an average of £40. 2s. 6d. in 1894 to £87. 1s. 8d. in 1907, but production has been uninterruptedly on the increase from 269,455 tons in 1890 to 839,255 tons in 1909. It is remarkable how steady has been the output of the Spanish and Portuguese group of mines—the Rio Tinto, Tharsis, and Mason & Barry—the production in 1890 being 51,700 tons as against 52,185 tons in 1909. Their lowest figure was 44,810 in 1905, but during the remainder of the two decades the total has been close to 50,000 tons of copper per annum, of which Rio Tinto has contributed 32,000 to 35,000 tons. Mexican production has increased notably during the last ten years, and is given as 56,240 tons in 1909, as compared to 19,335 tons in 1899, a result due mainly to the exploitation of the Cananea and Nacozari deposits. But the great fact that has dominated the copper market of the world is the tremendous growth of American production, from 116,325 tons in 1890, to 262,206 tons in 1899, and finally to 490,310 tons in 1909. The Lake Superior mines show an increase from 44,450 tons in 1890, to 69,363 tons in 1899, and 101,350 tons in 1909. Montana's output has grown from 49,560 in 1890, to 106,650 in 1899 and 140,665 in 1909. Arizona has done even better, owing to the new enterprises started in the Bisbee and Globe districts, for a production of only 15,945 in 1890 and of 54,793 in 1899, has now swollen to 129,945 tons in 1909. When the new low-grade porphyry mines, such as the Ray and Miami, begin to make an output, the total from Arizona will exhibit a further notable increase. 'Other States' exhibit an equally remarkable growth, for the 6370 tons credited in 1890 to these nameless regions had become 31,400 in 1899 and 118,350 tons in 1909. The 'Other States' include Utah and Nevada; hence the astonishing increase, which is still in progress and is today, with the Arizona expansion, the factor that most threatens the maintenance of even the present low price of copper.

The Copper Producers' Association reports the production of American copper in March at 53,601 long tons, which is an increase of 3600 tons. The stocks on hand at the end of the month are given as 55,279 tons, compared to 43,957 tons a month earlier.

Lead.—Despite the lack of new sources of lead production the market for this metal is depressed. Prohibitive legislation in France against white lead has enabled zinc white to replace the older lead paint, and as there is no increase of demand in other departments this loss of a market is keenly felt. Large stocks of lead exist and the difficulty in disposing of them threatens to lower the price.

EDITORIAL

THE ROYAL SCHOOL OF MINES old students will hold their annual dinner at the Hotel Cecil on May 26. It is desirable to specify the date so that the alumni scattered all over the world may plan their re-unions on the same day. We understand that R. S. M. dinners are likely to be held concurrently at Johannesburg, Dunedin, Kuala Lumpur, Calcutta, and probably also at Montreal. At the dinner to be held in London the chairman will be Sir Thomas H. Holland, until recently director of the Geological Survey in India. The honorary secretary is Mr. Arthur C. Claudet.

IN OUR LAST issue we stated that the Mining and Metallurgical Club was about to become a fact. We are now able to inform our readers that a finance committee has been appointed consisting of Messrs. Sidney H. Farrar, Walter McDermott, Edgar Tayfor, Arthur C. Claudet, and H. L. Sulman. Mr. C. McDermid has kindly consented to act as honorary secretary. About 500 members have been enrolled. The premises selected adjoin the St. Ermin's hotel, at Westminster. They are easily reached by the underground and tube railways, and are situated in a part of London already strong in engineering associations. It is anticipated that the re-decoration of the rooms will be completed in time to permit occupation early in May.

BY COURTESY of Mr. A. Beeby Thompson we are able to publish a timely article on the Maikop oil-field, which is the objective of recent financial activity. Several companies have been issued on the basis of property rights in this Caucasian district. As the author of the best of recent books on the petroleum industry, Mr. Thompson writes with authority. In our summary of company reports we give particulars concerning the flotations reflecting the public interest in the oil industry.

WE ADVISE professional men to take care that their names do not appear among the "addresses wanted." This list of derelicts is worse than a necrology, for it suggests those who are alive but dead or at least so lost to sight that the town crier has to be engaged to ascertain their whereabouts. The American Institute publishes such a list every month, but the names given in the March bulletin include several particularly lively individuals whose addresses we have forwarded to the secretary at New York. You are not really dead until *The Mining Magazine* has no further evidence of your existence.

AT its recent meeting the American Institute of Mining Engineers re-elected Mr. D. W. Brunton as president. We note with pleasure that Mr. Benjamin B. Lawrence was elected a vice-president, together with Messrs. Albert Sauveur and Joseph W. Richards. The last is far from being the least, for he is the talented editor of that excellent technical journal, *Metallurgical & Chemical Engineering.* During March the Canadian Mining Institute also held its annual meeting, and we note that Mr. Frank A. Adams was elected president, with Messrs. A. B. W. Hodges and R. W. Leonard as vice-presidents. A series of interesting sessions was held at Toronto.

LORD LANSDOWNE expressed lack of confidence in scientific experts as legisators. Sir Francis Galton writes to *The Times* to point out that primogeniture and heredity are not the same thing, and that the claims of the latter would be best satisfied if all the sons of a peer were equally eligible to the peerage, and a selection made among them. The expert on eugenics can afford to smile at senators who deprecate the presence of eminent scientific men in the upper legislative chamber. We also smile in a sardonic way at the omission to include engineers among the select legislators of a reformed Upper House or Second Chamber. It is true that Mr. Birrell associated 'miners' with 'Nonconformist ministers' as possible candidates, but it is only too sadly evident that engineering, especially mining engineering, is associated in the public mind with the Stock Exchange rather than with a constructive use of the scientific imagination and a beneficent application of economic geology. Barristers, of course, are eligible, but solicitors are off colour because they deal with business rather than rhetoric. In the elaborate precedence of a highly civilized community the mining engineer comes after the solicitor; he is not included among the learned professions but as one of those base utilitarians who use technology for the making of money.

THE ANNUAL general meeting of the Institution of Mining and Metallurgy passed off most pleasantly on March 17. We are pleased to record the fact that the new members of the Council are Messrs. Frank Merricks, A. L. Simon, and S. J. Truscott. Incidentally we may call attention to the fact that the President was elected in November, or four months before the Council was elected. Moreover, the President is not elected one of the Council, he becomes a member ex-officio, although the by-laws provide that he "shall be elected by the Council from the members thereof." We do not hesitate to mention this irregularity because the re-election of Mr. Edgar Taylor is so deservedly popular as to eliminate the idea of a personal criticism; we refer only to the procedure. Moreover the vice-presidents appear to be fixtures; we know of no way by which they are changed from year to year; apparently death or the presidency is the only cause for varying the list of the six vice-presidents. We have ten ex-presidents who are ex-officio perpetual members of the Council. Even these last do not rotate in and out of office as much as is desirable. The election of the officers of the Institution should be effected on a system more flexible and more in accord with the best current practice in such matters. Here again it is possible to criticize without offence, for the general feeling obviously is that the affairs of the Institution are well managed.

ALEXANDER AGASSIZ, who died on board the *Adriatic* on March 28, was a notable figure both in science and in mining. Born in Switzerland 75 years ago, the son of Louis Agassiz, a naturalist who opposed Darwin's theory of natural selection, he studied engineering at Harvard, after which he occupied a position in the copper-mining region of Michigan; he became interested in the Calumet and Hecla when that mine was in its infancy. He persuaded his friends, including his father-in-law, Quincy A. Shaw, to purchase Calumet and Hecla shares at a low figure and himself bought all the shares he could, thereby becoming a wealthy man and one of the leaders of copper mining in America. As soon as he was financially independent he became a student and patron of biological research, especially investigations into oceanography. For thirty years he continued to equip and direct oceanographical expeditions, the results of which are now stored in books and museums. He also built a museum of comparative zoology and gave it to Harvard, together with a sufficient equipment and endowment. This was done as a memorial to his father. The only return accepted by him was the appointment as curator of the museum and a letter from the trustees acknowledging gifts aggregating over $10,000,000 during his intendancy. For many years he was president of the National Academy of Science. His publications were numerous, especially those devoted to the origin of coral reefs and oceanic contours, on which subjects he was the leading authority. The life of Alexander Agassiz was a romance linked to industry; in his case the acquirement of great wealth only stimulated a zeal for scientific research. He deserves honour for that.

An Old Unit.

Our correspondent at Johannesburg makes some pertinent remarks on the adoption by H. Eckstein & Co., for the mining companies under their control, of a new system of reporting progress underground. It is proposed to adopt the 'square fathom' in place of the 'ton milled, as a basis of comparison between mines and managers. The scheme is credited to Mr. H. F. Marriott, the technical advisor resident in London for Wernher, Beit & Co., which firm is represented on the Rand by H. Eckstein & Co. Instead of stating costs and profits in terms of tonnage treated in the mills it is proposed to express such results per square fathom of ground stoped. These returns are to be reported quarterly instead of monthly, an innovation in accord with the suggestion made by Mr. L. Reyersbach several months ago and criticized in our issue of December last. However, the new system need not irritate shareholders for it is intended primarily for domestic use; we understand that the innovation will be introduced only in the reports sent to the directors and not in statements issued to the public. Thus much confusion will be obviated. The idea is to have a better check on the managers, whose efficiency cannot be gauged satisfactorily from the tonnage of ore milled or the results as expressed on a tonnage factor. Again it is recognized that the degree to which a claim-area has been exhausted is not accurately expressed by the number of tons sent to the mill, and it is desired to have a unit of exhaustion, as it were —a measure of the superficial area worked out. Using the square fathom as a unit it will be possible to shade the mine maps so as to indicate exactly how much ground has been removed, or, having an estimate of the square fathomage in a given lode-area it will be possible to state promptly how much of it remains to be worked at any given date. Of course, it is the A.B.C. of mine administration that the cost per ton is no final measure of managerial efficiency, nor, on the other hand, is the profit per ton wholly satisfactory as a record of achievement, for a present profit may be won extravagantly by exploiting rich ground at the expense of future operations. In brief, the most economical system of mining has an eye to the future as well as to the present; it involves the idea of interest on capital together with amortization. Mines should not be conducted in the interest of the man who buys and sells his shares within a twelvemonthly period nor is it desirable to administer the metalliferous estate in the interest of posterity. In this department of industry, as in life generally, a reasonable compromise is sought and attained.

Returning to the purely technical question of a choice of unit, we note the proposal of Mr. Marriott with pleasure not because it is perfect—for it is far from being that—but as indicating an earnest effort toward accuracy. The development of mining and metallurgical practice on the Rand has suffered from the inevitable obscurity of the returns, for it is well known that the percentages of extraction are based upon variable factors and the cost per ton is founded on conditions so diverse as to be not comparable. The sooner all the data reported by the managers are mutually intelligible the sooner the minimum cost of winning gold will be reached. That minimum may be in sight: it is believed to be about half a crown less than at present. Obviously, when the manager of a mine has ascertained his minimum of cost he can then proceed confidently to draw a line between 'ore' and 'waste.' That line has wavered, if it has not been fluid, and the uncertainty of its incidence underground has led to the loss of thousands of tons of ore now within the economic limit. It is true, however, that the proportion of ore discarded in old workings as being below grade is only 7 to 9 per cent of the amount developed, so that the time has nearly come to consider the advisability of extracting a full stoping-width continuously. The proposed unit may help to clarify this feature. But we shall await with interest the application of the new scheme of measurement. It is open to the obvious objection that it disregards the width of ore, hence a square fathom on a 12-inch lode may yield 3 tons while a 4-ft. lode would give 12 tons per square fathom. The inequalities in the stoping-width are disregarded. Here we ask why the fathom was selected as the unit? It is a return to old Cornish ways. The unit is not new; it is ancient, if not discredited. Why not adopt a cubic measure, preferably from the metric system? The cubic metre would be intelligible in every country in which South African mines are owned and it would cover the three dimensions that determine the tonnage extracted from any lode. In other words, if Mr. Marriott and his friends are to introduce an innovation, why link it to an anachronism?

Natal.

The report by Mr. F. H. Hatch on the mines and mineral resources of Natal is to hand. It gives valuable information to those interested in the development of that Colony. No vain circumlocution or deceptive ambiguity obscures the statement of conclusions reached by Mr. Hatch in the performance of his duty as consulting mining engineer to the Government of Natal. The report is a good one, not because it gives favourable opinions or attractive descriptions, such as might adorn future prospectuses, but because it tells the truth in a useful way. To tell unpleasant truths to useless purpose is a performance meriting dispraise; it is no more commendable than to "besmear the fair face of Truth with that most pestilent cosmetic, rhetoric." But this report errs neither way, it fulfils its purpose, which was to inform the Government—and, through the Government, the people—of Natal just what stage of development their metal mining industry had reached and what prospects it promised of further development. The result is disillusionment: but that is not the worst that can happen; from the clearer knowledge now available it will be possible to advance more intelligently and to afford systematic aid to the prospector, whom no departmental report will daunt in the hope of finding the wealth that is ever beyond the next range. But the promoter will be discouraged undoubtedly; for him no happy hunting ground is here offered. The potentialities are slim; the actualities are depressing. Until the prospector has uncovered gold veins, copper lodes, and iron deposits better than any as yet discovered in Natal, the cheerful activities of the financier had best be held in abeyance.

The investigation did not include coal, which is the chief mineral product of Natal. In 1908 the total value of the Colony's mineral output was £741,158, of which £737,169 was credited to coal, £2111 to lime, and £1878 to gold. Thus the dry eloquence of statistics tells the story completely. In his report Mr. Hatch explains how he sampled the prospects for gold and copper, finding low-grade patchy veins of the one and low-grade small deposits of the other. Only the Wonder appears to hold out any probability of becoming a profitable mine. The iron and manganese deposits are too poor and too impure to have any commercial value. But we note with interest, and hearty approval, that Mr. Hatch advises the local authorities to encourage prospectors and individual workers. This can be done by improving the roads and other means of communication, by supplying maps, and even offering bonuses or other rewards to the persistent seeker. Above all, the small worker should not be hampered by taxation or the imposition of fines. This is excellent advice. Too many Governments deem it to be their duty to facilitate the investment of capital instead of taking pains to encourage the creation of enterprise on which capital can be worthily expended. They put the cart before the horse. Natal has now no excuse for doing so. Finally, we congratulate the author of the report upon the general frankness and clearness of his findings, and upon having performed an unpleasant duty both wisely and well.

National Education.

Our contemporary *The Statist* in its issue of March 19 publishes a leading article on education as a means of increasing national efficiency. It augurs well for progress in such matters when a financial periodical can give advice so sound and well reasoned. One of the functions of education is to teach men to think for themselves; it is better that they should think wrongly than be merely the embodied echoes of other's thinking, for reason will appeal to and eventually guide a thoughtful man while it falls like spray on the rock of an illogical understanding. At the present time and in the recent election it has become painfully obvious that most of our people illustrate what Marion Crawford calls "the everlasting monkey in man," whereby they follow their leaders blindly and accept ideas at second-hand. The electorate of these islands in the North Sea settles the political destiny of one fourth of the human race, but neither the voters nor the candidates, neither the Parliament nor the Press, appears to be able to discuss imperial problems without an exhibition of prejudices worthy of a village vestry. Self-interest and class-interest smother the civic spirit and render it impossible to discuss broad questions in a broad way. The cure for this is education, using the word as implying the development of all the faculties necessary to the efficiency of citizens in a highly organized community. The writer in *The Statist* points out that until the last century England had only two universities and Ireland one, while the Scotch had many. The results were apparent. In England the universities were preserved for the privileged few, although originally intended for the poor and particularly those of them in training for the Church. Now we have a number of universities and in them the sciences take a position more nearly consonant with modern industry. Even Oxford and Cambridge recognize the signs of the times and endeavour to teach engineering. So far the results have not been remarkable but the attempt is noteworthy as recognizing the fact that the knowledge of the classics is an insufficient preparation for the multifarious duties of life. In developing the literary faculty the study of Greek and Latin is essential; in training men to participate in modern industry the faculty of intelligent observation is the first requirement. All human occupation rightly performed is based upon observation; in the basic industries of the farmer and the miner the first need is for rational induction from facts observed in nature. Hence the teaching of science underlies modern education to an increasing degree. The Germans appreciate this; the Americans know it, and apply it unreservedly. Our leading universities nibble at the idea as at something distasteful. We need a technical training for employees and we need it for employers, whether it be in the army or navy, on the farm or in the mine; it is essential that those in charge shall be placed in positions of authority because of their fitness by special training to direct operations the usefulness of which is dependent upon the correct application of scientific principles. British industry is handicapped by nepotism, family traditions, class favour, and all those various factors that tend to give authority to the unfit, to check the ambition of those that are fit, and to burden business with a pensionage that taxes profits, kills initiative, and smothers ability. A navy we need and a navy we shall need of the highest efficiency, but in the future the nations will strive in commercial competition, rather than naval or military, and to succeed in that rivalry the first weapon is a systematic scheme of technical education.

Something has already been accomplished, but much remains to be done. Not until our older universities include at least one college identified with the teaching of science and not until the prestige accorded to classical attainments is freely given to those who are versed in more utilitarian accomplishments shall we be prepared to meet other nations in the arena of competitive industry. When the knowledge of Greek ranks with the understanding of chemistry, when to talk German or Spanish is deemed as useful as familiarity with Latin, we shall have removed the idea that the classics constitute learning and that technical science is only a means for making money.

Gold in Country Rock.

The paper on the detection of minute traces of gold in country rock, by Mr. Arthur R. Andrew, with the discussion that ensued before the Institution of Mining and Metallurgy, proved illuminating in unexpected ways. The author frankly acknowledges that his research failed on account of the impurity of the lead used in collecting the gold in the samples of rock. All the litharge tested was found to contain an appreciable quantity of the precious metals. Thereupon several ingenious suggestions were made for the manufacture of pure lead by reduction from the acetate, by precipitation as chloride from a nitrate solution, and by repeated electrolysis in a fluosilicate solution; but each suggestion was coupled with a frank admission that the purest product would not be entirely free from gold and silver. Memories of the greatest assayer that ever lived—Richard Smith—were revived by references to the work he did fifty years ago in the detection of gold in lead compounds, and it was made plain that the latest investigations were no farther forward as regards the practical difficulty of testing rock for minute traces of the precious metal by any process involving melting in lead. The mention of 'traces' reminds us of the dialogue between the President of the Institution and Mr. A. C. Claudet, in which the former tried to elicit from the latter a definition of that indefinite term. The elusiveness of the reply would do credit to the medieval schoolmen debating the psychology of a chimera in a vacuum ruminating upon the advisability of second intentions. Joking apart, we deem it not improper to suggest that these pleasant but utterly unscientific conversations might well be eliminated from the printed records of the Institution; we even go further and suggest that the discussion as it appears in Bulletin No. 66 would gain by severe editing; much of it was harmless talk at the time it was spoken, but it is undignified nonsense now that it stands in cold print. Mr. George T. Holloway, however, raised the level of the discussion by some pertinent observations, one of which was the fact that the minute buttons finally measured by aid of a microscope, with a view to ascertaining the quantity of gold in the rock, were misleading at the best, for the silver in them had not been removed, and in most cases such buttons would be likely to contain more silver than gold. We may add that the miscroscopic method is based upon the supposed spherical shape of the buttons, and as they are not true spheres the method suffers in accuracy. Mr. Holloway joined, with Mr. A. M. Finlayson, in commending the use of cyanide for the selective solution of minute quantities of gold in rock. By treating large samples and by checking the gold existing as an impurity in the materials employed, it was possible to obtain instructive results. The error due to gold in the metal used to complete the cyanide extraction, and that due to any gold in the flux or crucible, could be minimized by treating a ton of rock, and would be about one ten-thousandth of the error introduced in treating 100 grammes by direct fire-assay, as was done by Mr. Andrew and in the earlier experiments of Mr. J. R. Don, in New Zealand.

But, after all, what was the purpose of this analytical work? Supposing it had been proved, as others have claimed to have proved, that gold exists in minute quantity in country rock near gold veins, what is to be the scientific inference? Are we to conclude that the vein was enriched by the leaching of the adjacent rock, or are we to believe that the mineral solutions that formed the ore also impregnated the rock traversed by the vein. Might not the absence of gold in the country rock be a proof that the metal had been removed previous to enrichment of the lode-fracture, or should we infer that the poverty in gold indicated the inability of the rock to serve as a source of gold for the vein? Manifestly, the condition of the dark silicates, supposed to carry the metals in the country rock, would have to be investigated. The silicates containing traces of gold might formerly have contained more, and might have contributed what they lost to ore-forming agencies; or the little gold that they are now found to contain may have been derived from solutions that penetrated into the rock from an adjoining fissure or system of fractures. It seems clear that the assay of samples of rock is a childish way of getting light on a subtle problem and that microscopic examination into the chemical condition of the basic silicates affords a more likely line of enquiry.

Memba Minerals.

Among recent prospectuses advertised in the daily Press we note the Memba Minerals Limited. This is a company formed to acquire and explore a concession in Portuguese East Africa, mainly on the strength of a report by a Mr. Max Schoeps, F.R.G.S. In the first place, it should be obvious that fellowship in the Royal Geographical Society indicates no fitness for an appraisal of mining possibilities, for it affords no assurance whatever that the person entitled to add the luminous tail of F.R.G.S. to his name has ever managed a mine or undergone the training necessary to fit a man to act as an expert adviser in mining affairs. In the next place we note that Mr. Schoeps is a director of the company and is therefore not in a position to give an unprejudiced opinion. Finally, in the extracts from his report as published in the prospectus we find further evidence suggesting that his opinion is not reliable as regards the prospects for profitable gold mining. The only direct testimony bearing upon the subject is contained in a paragraph describing an alluvial deposit. Mr. Schoeps states: "During my stay in the Lomue country I had the good fortune to locate an alluvial gold deposit which I carefully prospected, weighed, and panned down to a depth of from 6 to 8 feet, taking numerous samples over a distance of about two miles, the net results averaging $1\frac{3}{4}$ ounces of gold per ton." This statement is not in the least convincing; it is not explained how the gentleman "prospected" and "weighed" a deposit two miles long; we are not told how many samples he took, or how he took them. In default of such evidence, the general statement is valueless; and it is rendered improbable by the assertion that the net results averaged $1\frac{3}{4}$ ounces of gold per ton. If it did, the deposit, even for a depth of 8 feet, and a width of 100 feet, contains 750,000 ounces of gold, worth £3,000,000. Other rich alluvial deposits are said to exist on the concession and "there is scarcely a stream from whose sand gold cannot be washed and profitably worked by dredging." This also is a large statement, requiring facts to support it, particularly facts gathered by persons having experience in such matters, namely, mining engineers.

As the shares rose to a premium within a few days of issue, it is apparent that the public likes fine and large statements as a basis for speculation. The capital of the company is relatively small and a profitable deposit of any one of the minerals mentioned in the prospectus would be enough to justify the venture. But we trust that mistakes will not be repeated: having accepted the report of a geographer interested in the venture, we hope the directors will recognize the duty they owe their shareholders by conducting the work of mineral exploration and mine development under the advice of one or more men qualified by experience in such matters to direct the proper expenditure of their capital. If this is a private company the answer will be that it is nobody's business but their own how the organizers of it spend their money, but the fact that a prospectus has been advertised and that shares are being sold to the public warrants us in proffering these suggestions.

West Australian Ore Deposits.

On another page we give a précis of a paper on this subject read by Mr. A. Montgomery before the Australasian Institute of Mining Engineers. This is a valuable contribution to economic geology and we commend it particularly to the attention of those engaged in directing mining operations in Western Australia. As is generally known this region represents the stump of a continent, it is the basal wreck of a land-surface formerly more elevated, and composed now of pre-Cambrian rocks, complex in character. The series of rocks includes highly metamorphosed sediments, in part schistose and in part so massive as to resemble igneous matter. For purposes of description the comprehensive term 'greenstone' has been applied to this terrain by scientific men, while the miners of the country generally use the term 'diorite.' This ancient formation exhibits foliation and folding of an extreme character, ascribed to regional movement associated with the intrusion and eruption of granite. The gold veins are found chiefly in the greenstone near the contact of the latter with granite. Both the granite and the greenstone are labelled pre-Cambrian, and both are penetrated by later dikes of basic composition. But Mr. Montgomery lays but little emphasis on these: he ascribes the gold-bearing veins to the period of stress and strain that laminated the pre-Cambrian rocks and he concludes that the lodes now found at surface were originally formed deep in the heart of mountain ranges long since eroded to the level of a continental plateau. The evidence, however, is far from conclusive. No strata of undoubted Paleozoic age have been found overlying the greenstone country where traversed by gold veins; apparently today, as ten or fifteen years ago, the geological testimony as to the period of vein-formation is defective. We are not impressed by surmises implying great geological antiquity. It is pleasant to suppose that the veins mined today were formed in the geological dawn, for that involves the gratifying expectation that they will exhibit scant changes in depth, the erosion to which they have been subjected already being so tremendous as to make the deepest mining operations appear relatively insignificant. If a vein has been eroded for five or ten thousand feet it is probable that a shaft sunk two or three thousand feet will disclose no violent changes in the character and composition of the ore. But much stronger evidence than any heretofore available will have to be brought forward in order to substantiate such a theory. The age of a vein is not always ascertainable: the age of the ore in the vein is determinable with even less certainty; but neither the one fact nor the other is as important as information regarding the age of the concentrations that constitute rich ore. The miner, of course, must find a lode before he finds ore, and ore of some kind before he discovers the particular kind adapted to his purpose, but it must be understood clearly that 'ore' means rock profitable to exploit, not merely the mineral aggregates whose origin it is profitable to discuss nor the substances that are interesting to the scientific man. Mr. Montgomery makes the important observation that the lodes in various districts of Western Australia are evidently of different ages, and that different portions of the same lode have been formed at successive periods. Even the foliation and plication of the country need not be due to movements confined to pre-Cambrian time; on the contrary, it is more than likely that these old rocks have yielded to repeated and successive orogenic disturbance throughout geological time. As Mr. Montgomery allows, in the Swiss Alps we find Cambrian schists that have participated in such movements even later than the Cretaceous period. But there is a wider reason: What evidence we possess of the origin of veins of metallic ore goes to prove the geological recency of mineral deposition. Most ore deposits of known age are geologically juvenile. In such a case as the Homestake, where the lode is known to have existed in Cambrian time, the enrichment constituting ore is related to dikes that are seen to penetrate Cretaceous beds. After all, the age of the rocks penetrated by veins is less important than the composition of those rocks, and the composition is less important than the structural conditions favourable to such fracturing as creates a passage for the penetration of mineral solutions; and the conditions affecting such deposition are secondary in importance to the later events contributing to the removal of metals from one place and the deposition of them in another place, thereby causing the enrichments and impoverishments that are the vital fact in the extraction of ore from a hole in the ground.

Mr. Montgomery deduces not only the great geological age of the gold veins but he concludes that as the present surface is not greatly different from successive former levels of denudation, "the opportunity for secondary chemical changes in the superficial parts of the veins have been extraordinarily good." To this he ascribes the peculiarities of West Australian lodes and especially the short-lived character of some of the rich discoveries. He deems this intense superficial chemical action peculiar to Western Australia and refers to it as "somewhat difficult of appreciation by visitors accustomed to goldfields elsewhere." But similar conditions are not unknown in wide tracts of North America, and in South America, in Queensland, and in other countries where an arid high plateau renders the drainage saline and exposes the rock to irregularities of atmospheric temperature, both diurnal and seasonal. The idea that the salt in the surface water of Western Australia is due to the submergence of the region beneath the sea during recent geological time is untenable; obviously, it would not explain conditions duplicated in parts of the earth now two or three miles above sea-level. Nor need the fine or 'mustard' gold of Kalgoorlie and Kanowna be attributed to the prevalence of salt in the drainage, for similar gold has been found at Cripple Creek, two miles above the sea and many hundred miles distant from the coast. In Colorado the 'mustard' gold is derived from the decomposition of tellurides. At Kalgoorlie a similar connection seems probable, and as to the crystalline gold in the cement deposits of Kanowna, that may well have been laid down, as Mr. Montgomery suggests, in place from solutions permeating the drift. But even this form of native gold is not peculiar to Western Australia. There is, we submit, more to be learned by comparing conditions obtaining in one region with those observed in other regions, than by assuming abnormality for any one of them.

R. W. Raymond.

On April 30 it is proposed to present a testimonial to Rossiter W. Raymond. The occasion will also be marked by a dinner "tendered by his friends in token of their affection and esteem." We would like to have been able to attend this function and we know that our wish is shared by men scattered the wide world over; for the event celebrates the seventieth birthday of Dr. Raymond. The dinner is at seven o'clock at the Plaza Hotel; even those who are absent can remember the time and date, so as to drink to the prolonged life, continued usefulness, and further happiness of one who is the *doyen* of the mining engineering profession in America.

stimulate youth and those emulous of good deeds. *Il faut encourager les autres.*

The career of Dr. Raymond synchronizes with the growth of mining engineering across the Atlantic and is identified with the development of the mineral wealth of a continent. When he was born in 1840, the mining industry of the United States had made a feeble beginning; when he went to Freiberg in 1860 there was no School of Mines in America; when he served in the Union Army during the four years of the Civil War the discoveries of gold in California and silver in Nevada had created highly productive industries, and when he filled the post of Commissioner of Mining Statistics, from 1868 to 1876, he assumed a leading part in the application of technical science to mineral exploitation. As a lecturer on economic geology and as the editor

ROSSITER W. RAYMOND.

As our readers know, we have no liking for the sickly sentimentality expressed by the saying: *De mortuis nil nisi bonum;* we hold that public men must be judged by their acts and by the effect of their acts, and that pernicious personalities should be properly estimated at a time when their careers are undergoing human appraisal. On the other hand, we deem it a sad blunder to postpone praising a beneficent character until kind words fall on deaf ears. The praise of the living serves to successively of two mining periodicals he developed the ability as a journalist inherited from his father and used to splendid effect when in 1884 he became Secretary of the American Institute of Mining Engineers. This post he has held uninterruptedly for 26 years, so efficiently, so completely, and so vividly, that the Institute has become identified with his name and personality. He practised as a consulting engineer after he resigned his Federal appointment, and in later years he has acted in an advisory capacity, especially in mining litigation, a department in which he early achieved a unique position as a skilful advocate. Since 1903 he has been lecturer on mining law in Columbia University. Of his other multifarious activities it is not necessary to speak at this time save to emphasize an exceptional versatility, which he has placed at the disposal of the public interest on many and diverse occasions. George W. Maynard, one of his oldest friends, tells a story illustrating Raymond's versatility. On being asked to dine, he declined, explaining that he was delivering a lecture on 'Storms' upon the evening specified. "What do you know about storms, anyway?" said Maynard. "Nothing" said Raymond, "but I'll know all about it before Friday." And he did; he went to Washington, discussed some of his ideas with the experts of the Weather Bureau, and returned in time to deliver a lecture that easily indicated to his Brooklyn friends that he knew all that was worth knowing about storms. It is open to question whether he plays chess better than he plays whist, or writes hymns better than he composes stories for children, whether he is stronger as superintendent of a Sunday school or as leader in the intellectual jiu-jitsu of a mining lawsuit, whether he preaches in Beecher's pulpit better than he lectures at Columbia, whether he talks more convincingly than he writes, and finally whether he is a great mining engineer or only a great man. Undoubtedly Raymond's work as editor of the *Transactions* of the American Institute is his greatest service to the mining industry. Here he has proved himself incomparably able and stimulating. Many of the best writings on technical science have been prepared on his initiative and at his suggestion. For more than twenty years the *Transactions* have been enriched and concentrated by the labour of his pen until the successive volumes constitute a magnificent reference library of well digested technical information. If he had done nothing more, the *Transactions* would be achievement enough. And he has done so much more. As a friend of R. P. Rothwell he collaborated on the *Engineering and Mining Journal* for many years and there is hardly a technical periodical of the first class that has not been enriched with the products of his pen. His style is marked by force and consecutiveness. An unusual range of experience gives vigour to his fluent pen. All knowledge is his patrimony, to such an extent as occasionally to prove embarrassing. A member of the Institute will rise to read a paper describing in detail his researches into a subject; when the last word seems to have been uttered, the learned Doctor rises and refers in a casual sort of a way to some investigations of his own; after a modest preface he proceeds to run rings all round the poor man who has done his little best, until it is uncertain whether humour or pathos is to prevail. In controversy he delivers sabre-thrusts of Saxon speech with an effect that can be described as deadly or delicious according to the point of view. Here we are reminded of a story that Clarence King used to tell. King described how he was walking up a mountain trail near Silverton, in Colorado, when he met a mule train; he passed each animal carefully until he approached the last one. He hesitated, and turned to the 'packer': "Is that mule vicious?" "No," said the man in charge of the mule train, "he aint exactly vicious, but he is kind of versatile with his hind hoofs." That, said

Clarence King, describes Raymond when engaged in literary controversy.

Of course, he is, and has always been, the life and soul of the Institute meetings. Presidents can come and go, but the Secretary remains. It would be invidious to compare the easy grace and confident skill of the Secretary, as a speaker, with the clumsy but well meant efforts of those who have filled the honourable office of the presidency, but such comparisons have been inevitable. At times the revolution of the Institute around its Secretary has proved embarrassing even to the Doctor. From such embarrassment he extricates himself readily. The present writer remembers how at Aspen in 1896 it was suggested that someone should tender the thanks of the visiting members to the local committee and to local citizens for facilities and hospitalities provided. As the president and other members were successively invited to discharge the graceful task, each said: "Oh! No, better ask Raymond to do it." Finally the Doctor rose, prefacing his remarks with an apology for seeming reluctant to perform an obvious courtesy and explaining his position by reference to the story of a boy whose father had served in the Civil War and had talked so much about his own doings in the campaign that the small boy finally put the question: "Pop, was there anyone else in that War?" Most of us thought that if there were 'others,' they failed to make themselves numerous. And at Chicago, in 1893, on the occasion of an International Science Congress, the leaders of thought on various subjects had spoken, in French, in German, in broken English, without igniting a spark of sympathy or illuminating a line of thought. Then rose our Secretary. He did not begin with the conventional "Ladies and Gentlemen": he startled his audience by addressing them in his Plymouth Church style as "Brethren." Then, referring to the purpose of such an international gathering, he said that we had come there in the hope perhaps of lighting on something new, some invention or theory, or of discovering a fresh technical method, but we had done better: we had "discovered one another." There he expressed the one salient feature of such a meeting of scientific men from every part of the world. It was the one great fact made evident amid a multiplicity of speech-making, and it was stated by Raymond in words that I have only feebly outlined. This happy faculty for expressing clearly the inchoate ideas of a large meeting is the mark of the born orator. His is "the brightness of carved speech."

Another less cheerful characteristic is a fondness for writing obituaries. His assistant and nephew, Theodore Dwight, told me how he schemed to check this lugubrious propensity. It was arranged that while ample space should be given in the pamphlets issued by the Institute, the obituaries should, as far as possible, be kept out of the *Transactions*. But that was a mistake; the obituaries that Raymond writes are more inspiring than the presidental addresses of most men; like the burial service of the Church of England they are meant not so much to honour the dead as to inspire the living. They do. We confess to having read all of them, as they have appeared, and finding in them sound philosophy, deep religous feeling, and highly stimulating thought. Men think all men mortal but themselves, but if their mortality be once faced, they should wish that their obituary may be written by one so kind, so sympathetic, and so eloquent.

But this is no panegyric; it is simply a greeting from those of us who would like to be at the 70th birthday dinner and are prevented from participating in that delightful celebration. For ourselves, for the members of the Institute in distant lands, for the profession in general, we venture to express to Rossiter W. Raymond an affectionate regard that is and will always be

"Above the mere fortuities of place
And cold interposition of the sea."

METAL MARKETS

COPPER.

Average prices of standard copper:

March 1910.	February 1910.	March 1909.
£59. 7s. 1d.	£59. 10s. 6d.	£56. 6s. 8d.

The month has witnessed a further extension of realizations by tired speculators especially in America. The 3 months price gradually went downward from £61. 12s. 6d., and there were two sudden drops, one in the middle of the month after the publication of the American figures, and another in Easter week on the collapse of copper shares in New York.

Reports which reached this side from America that the February figures of the American Producers Association would show a strengthened position had been generally accepted, and some fresh speculative buying was induced, although with little influence on prices. Disappointment therefore produced heavy selling and a relapse in the price to £59. 17s. 6d. took place when on the publication of the figures a decrease was shown in deliveries amounting to 25,000 tons as compared with January and an increase of nearly 4000 in the stocks. The much discussed decrease in production had not materialized. The exports showed a decrease of 20,000 tons which explained away the enormous exports given out for January.

The collapse in prices was arrested by the distribution of supporting orders over the market, but in the absence of any general speculative enterprise no upward movement could be maintained, and liquidation was renewed culminating in the Easter collapse to £58. 17s. 6d.

The New York influence has been bearish during the whole month and still remains so, but the selling by stale bulls, the cessation of shipments by Americans for storing in European warehouses, and the continued decrease in the total visible supplies here have made the position much stronger. The consumers' demand has been and remains excellent in America and in England, and while on the continent earlier purchases were at first still sufficient to meet trade requirements buyers there also are now again purchasing on an extensive scale. Consumption is going ahead of American production, and seems destined to increase further in the immediate future. The trade however is still awaiting with impatience more tangible evidences of the decrease in production so long proclaimed by the interested parties in America.

TIN.

Average prices of cash tin:

March 1910.	February 1910.	March 1909.
£147. 4s. 11d.	£149. 13s. 0d.	£130. 6s. 7d.

Tin has been largely under the influence of the threatened coal strike in South Wales and of the unexpected statistical position of stocks. The February figures showed a decrease of 2507 tons in the European stocks, but an increase in America betrayed a disappointing trade position. Eastern selling, the selling of surplus stocks by Welsh tinplate makers, and the absence of bull support drove the three months price down to £145. 10s. by the middle of the month, a fall of nearly £7 from the beginning. At this level a better demand from consumers induced by the better strike news and assisted by a decline in shipments from the east induced bear covering on a market poorly supplied with stocks. American deliveries also improved at the same time and the month finishes with a strong tone and the three months price at £155.

LEAD.

Average prices of soft foreign lead:

March 1910.	February 1910.	March 1909.
£13. 2s. 8d.	£13. 7s. 2d.	£13. 8s. 8d.

Speculators have been steadily realizing their holdings during the month and have driven prices down about 10s. General trade has been good and in England the provinces have bought well and steadily during the whole period. The continental demand has also been better, owing to reopening of inland navigation, and a satisfactory number of export orders has been placed.

During the Easter holidays arrivals in London were larger than the trade anticipated and prices consequently suffered and rather frightened buyers, but the tone has since steadied.

SPELTER.

Average prices:

March 1910.	February 1910.	March 1909.
£23. 0s. 7d.	£23. 3s. 1d.	£21. 8s. 8d.

Spelter has been dull and slow of sale. Galvanizers while they continue busy are well covered for the work they have in hand and no fresh orders have come forward to necessitate further purchases. The Syndicate, to stimulate business, has waived the premium that was asked for forward delivery, but the response from the trade has been disappointing. On the other hand sales are not being pressed on the market.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Mine - Managers and Economics. Percy Cazalet, in his retiring address as President of the Mine Managers' Association, referred to a variety of topics with such lavishness of detail that it may appear ungenerous to pick out one single subject for discussion. As a technical review his speech was admirable. But it was so comprehensive that any attempt at concentration would lead to an inevitable overflow of the vats provided by *The Mining Magazine* for the treatment of Johannesburg pulp. I shall, therefore, merely endeavour to get a fair extraction from one particular parcel of remarks—the more interesting on account of its decidedly refractory nature. Mr. Cazalet drives straight at the bogey of 'low cost' per ton milled. Elsewhere he has a powerful ally in H. F. Marriott, who, strongly entrenched in the Corner House, has evidently promised aid in case of a counter attack from the loyal supporters of the 'low cost' banner, which has waved so proudly (and so deceitfully ?) over the Rand during the last two years. This personal combination is so strong and influential that one knows the *casus belli* cannot be shadowy and the results must be far-reaching. Mr. Cazalet opened the attack : "We hope that before long the bogey of 'cost per ton milled' will have been permanently scotched, to be replaced as a 'divisor' by the much more accurate 'square fathom exploited.'" He also said: "If a system were generally adopted whereby a comparison of profit derived from areas exploited were made the basis of comparison, the Rand, I believe, would show a greater profit per area denuded of its valuable product and that I feel sure, is the thing we are all, or should all, be striving for." Now, the abuse to be checked is clear enough. It is simply that of sacrificing grade to costs—that of milling as much waste rock or unprofitable lode as will pass criticism in order to make a good showing in 'economical' management. Has the new scheme solved the problem ? Will there not be abuses as great under it as before ? The *South African Mining Journal* gives a sound analysis of the new policy, with authentic details. The analysis-sheet transmitted by Mr. Marriott to the Eckstein mines is to be prepared on a quarterly basis as a "step towards breaking down the harassing monthly system of presenting equalized gold returns to the general public." The test of skill is to be based on profit per fathom; this is the outstanding feature of the whole scheme. Every actuary will commend

De Kaap Goldfield.

it. As regards the effect on mining, the obvious tendency will be to make managers work their best ore irrespective of working convenience, and raise the grade irrespective of cost, for while cost may rise 2s. per ton (to employ the doomed term) it may be possible to raise the grade 4s. by temporary selection. This, the advocates of the scheme favour. They wish to see the best ore worked first so that the greater profit may be in the bank and bearing interest. This is done today, for unprofitable blocks are generally neglected, unless, under stress of mining conditions and short mill-tonnage, it is a case of mining ore on the limit or nothing. Carried to extremes, the exploitation of the richest blocks only must lead to serious dangers.

Follow the normal sequence of events: It is announced that the cost per ton milled is a relic of administrative madness. (There are several managers with high costs per ton, owing to their inability to make or keep good miners, to collect a good staff, to get departments to pull together and to organize efficiently, who, glad of any change, will endorse this postulate readily). Further, that the management will be judged by profit per fathom. If the manager has been dishonest with the old system he will be the same under the new—will leave payable bands on 'foot' and 'hanging,' not helpful on the fathomage basis—which may be lost upon the caving of the ground. He will also search the mine for the richest blocks, so as to enable him for a year or two to win a reputation by progressive improvements in profit per fathom. Mr. Cazalet would not be able to deny that the effort, after increasing profits per unit of area, must trend in this direction. This point cannot be debated; it is apparently approved by the advocates of the scheme. In opposition to its technical merits, I venture to quote the words of one of our soundest mining authorities: "The maximum profit can only be gleaned from a given mine by wholesale exploitation and the confining of this work to a few large working faces and levels as only under these conditions is it possible to use mechanical appliances economically and to so concentrate the labourers as to thoroughly supervise their work." The authority is Mr. Cazalet, who thus expressed his views on true economy in mining in a few minutes before mentioning and supporting Mr. Marriott's opposing aims.

What is the conclusion to be drawn from this contradictory argument? Clearly, that we should aim at treating the best ore first—but not go too far; also at concentrating operations for wholesale exploitation—but not go too far. We take the golden mean and find ourselves after a troubled journey through the paths of mining economics back again at the starting point of current practice, in which cost and profit per ton milled provide intelligent data for public use. Supplementary information is provided for those who need and understand it. Let the 'profit per fathom' find its place as a valuable and instructive item in this supplement. Then will Mr. Marriott's ingenious scheme provide its good influence without leading to abuses inevitable when it is applied exclusively.

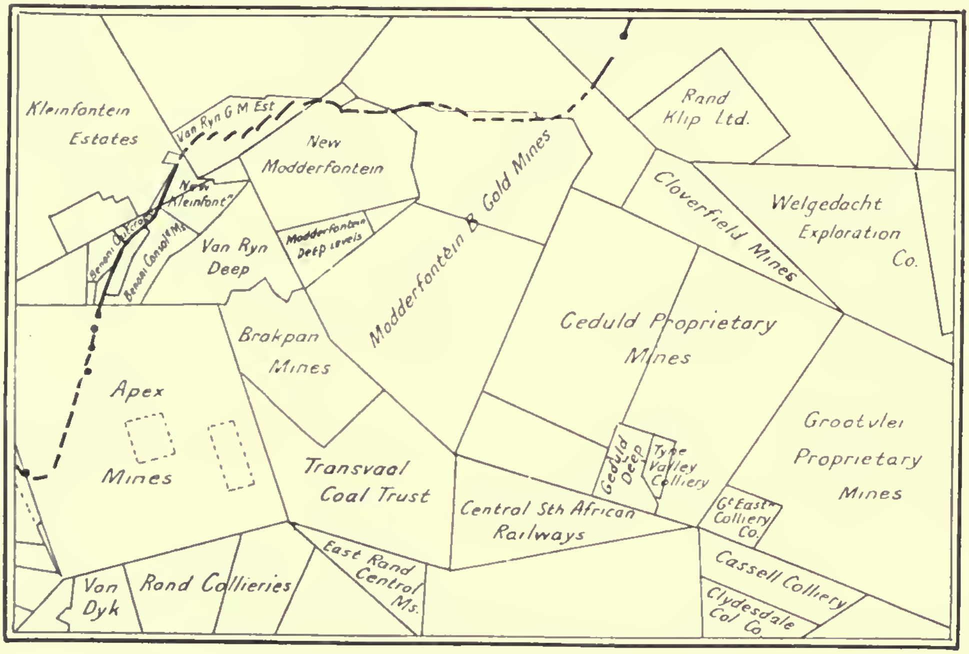
Labour Problem.—The season of annual meetings, when chairmen are called upon to give an account of their stewardship for 1909, is now at hand. Though many will be obliged to note the ill effect of labour shortage in the latter half of the old year, it will be possible to refer to the decided improvement at the beginning of the new year. Once again, the tally of non-white unskilled workers can be recorded under the general head of 'coloured,' for the last of the Chinamen—bar convicts—has gone. The coloured workers on gold mines now aggregate 10,000 in excess of the total in October. The unsatisfied demand is, however, still great: it is probably not less than 25,000 on producing mines alone.

The State Mine.—The Government is taking such an active part in the expansion of industry, by selling mining rights under water-rights and leasing big areas on the sliding-scale profits-tax basis, that people have almost forgotten about the provision in the new Gold Law for the operation of Government ground by the State itself. The scheme is likely to be put into effect in conjunction with the establishment of a training school for miners. The York mine, at Krugersdorp, was examined by a highly competent engineer with a view to determining its adaptability to the purpose. The result is unknown as yet. This preamble, however, is merely given to introduce and explain the announcement that the Government is now drilling upon its ground to the east of the Modderfontein B company, presumably for data bearing on its prospects as a State mine. It is probable that further information will be sought in this quarter before the question of a State mine training-school will be settled or other investigations made.

Miners' Phthisis.—J. W. S. Langerman announced at the annual general meeting of the Chamber of Mines that arrangements for the establishment of a sanatorium for the treatment of miners' phthisis had been completed. The Government has granted land and buildings, valued at £5550, and will contribute half the cost of maintaining the institution (not exceeding £5000 per annum), the Chamber of Mines providing the remainder. The mining companies will spend £39,000 in altering the existing buildings and in new construction. The Chamber has thus clearly proved that it is not apathetic to the needs of the miner who wrecks his health by underground duties. Tenders have already been invited for the work of erecting the sanatorium.

Vogel Deep.—The initial milling results of the Vogel Deep, which caused a startling fall in the market valuation of shares, have been the subject of much local discussion. There has been no lack of theories in explanation or of criticisms in condemnation. The ore reserve, as re-calculated at December 31, 1909, was estimated at 183,582 tons, of which 177,934 tons of the South Reef have an average value of 7 dwt. over 30 inches. This valuation is less than that previously made, owing to the influence of new winzes and raises, which show a lower value than the drifts, for some reason hard to explain, if disclosures are complete in both classes of work. Milling results put a different complexion on the position, even after allowance is made for the inclusion of low-grade ore from development faces; after sorting, the screen-samples averaged substantially less than the ore-reserves valuation over stope-width. The chairman of the company explained at the annual meeting in March that a "bad hanging wall necessitated the stopes being carried *somewhat* wider than 30 in. upon which the value of the ore reserves was based," that the "winze connections show the stope values to be *somewhat* lower than those obtained in the drives" and also that the inefficiency of the natives proved to be a "*somewhat* serious handicap." Looked at from another standpoint it may be said that the assumption of a 30 in. stoping-width would be *somewhat* too optimistic for any Rand mine, that the company started milling *somewhat* too early and that, as a result of difficulties and exaggerated rumours, the value of its shares *somewhat* declined—40% in a week. For the sake of a portion of the Rand of which we have exceptionally little information as to deep-level conditions, it is to be hoped that the Vogel Deep makes a better showing. It has made a false start truly, but there is plenty of time for reparation. There has been no occasion for a scare as to the prospects of the district.

Government Mining Leases.—The prospectus of the company formed by Barnato Bros. to work the Government leases of 2633 claims on Modderfontein No. 167 has been issued. The concern appears under the clumsy name of Government Gold Mining Areas (Modderfontein) Consolidated, Ltd., and with a rational capital of £1,400,000. The capital (1,400,000 shares of £1 each, all issued at par) is divided as follows: 450,000, fully subscribed and paid-up in full by promoters; 775,000, subscribed at par and paid-up to the extent of 2s. by promoters, the balance being due as required (much after the method adopted by the Turf Mines control, once extravagantly criticized by a member of the present Ministry); 175,000, offered for public subscription to bona fide residents in the Transvaal. The public issue is the most interesting item and the applications promise to total a figure greatly in excess of the issue. It is stipulated that applications must be for not more than 400 shares and not less than 10. It is to be hoped that the applicants for small lots will be considered, otherwise the proxies for 400 will absorb a large proportion of the issue. It is really remarkable how many clerks, office-boys, doorkeepers, cooks, housemaids, and other small dependents of big men, are able to produce certified cheques for £400 at short notice. All applications have to be accompanied by



THE FAR EASTERN RAND.

remittance in full—a provision meeting with keen criticism from those who consider that the issue should be popularized. It must not be forgotten that the Government is disposing of mining rights properly belonging to the public. 'Pegging' is prohibited because it would be impracticable upon such valuable ground. Lotteries are barred—at all events, of the old kind—for the present scheme possesses many features of a lottery with small prizes, but many of them.

Cinderella Amalgamation.—The man who attempts to draw a close comparison between the new Cinderella amalgamation (involving the Cinderella Deep, Hercules Deep, Leeuwpoort, and other areas at great depth) and the Crown mines, must possess a happily elastic spirit of optimism, in favour of the East Rand or of the Albu group. It is true that the new Cinderella Consolidated Gold Mines, with its capital of £1,159,450 and its great area of 2092 claims, makes a big showing, but it is one of those cases where preliminary promises and suggestions are so glowing as to create instinctive distrust. The whole proposal has been introduced with extravagant assurance of magnificent results. Two new shafts will be sunk to cut the 'reef' at about 3000 ft. Details of the development policy need not be considered, as it all hinges normally upon the connection of the three main verticals. It is proposed to "erect a central plant" (no one can criticize this wise provision) for an increase of productive capacity up to 100,000 tons per month. The plant will lend itself to be easily extended "to deal with a monthly tonnage of 200,000 tons." It is pointed out that on a basis of 100,000 tons milled monthly the annual profit may be expected to be in the neighbourhood of £600,000, and when ultimately dealing with 200,000 tons a month, it should exceed £1,000,000. The Consolidated company is to "enter on its extended sphere of influence . . . . amply provided with working capital for the considerable expenditure entailed in the extensive shaft-sinking and development operations and the very appreciable increase in the reduction works." Your correspondent is unreservedly of opinion that the energy of Albu Bros. in the Boksburg area will be well repaid and that the ground is well adapted to amalgamated working, but such excessively optimistic views at the present stage cannot be passed with confirmatory approval. To the ordinary investor, the programme is so simple as to be dangerously attractive. Here are £681,000 cash and 2000 claims near the East Rand Proprietary. Down go two more shafts and up goes a central mill, capable of ready expansion to 200,000 tons per month (the velt is wide). Result: another Crown Mines, to whose reports investors may be referred for guidance. The question of the relative value of the ground is too problematical for discussion. But this point is certain: the £681,000 cash provided is not nearly enough to sink and equip the two new shafts, to build up the enormous ore-reserve demanded by such an ambitious programme, and to erect the central mill of 200,000 tons capacity. Shafts and development alone would absorb £500,000.

Crown Mines.—The meeting of the Crown Mines, Ltd., held on March 8, enabled the board to give a satisfactory statement which should have reassured those who have been over-anxious as to the significance of recent results. The great amalgamation has not achieved results as good as anticipated on the basis of ample labour and this point made some shareholders dubious regarding the benefits of the whole scheme. There is a big difference between a speech of explanations and one of excuses. The Chairman's address was in part of the former character, but at the same time full of straightforward information. The results of the Crown Mines for the second half of the year are compared with those of the constituent companies for the first half, as follows:

	January-June.	July-December.
Tons milled...........	829,473	740,924
Yield per ton.........	32s. 6·7d.	33s. 8·9d.
Costs per ton.........	15s. 1·5d.	16s. 9·8d.
Profit per ton.........	17s. 5·2d.	16s. 11·1d.
Total profit............	£723,027	£627,135

Owing to the higher average grade, the profit closely bears out Mr. Reyersbach's estimate. Labour shortage has been at the bottom of the difficulty in maintaining the full tonnage. The company's ore reserve approaches 4,000,000 tons at 7·7 dwt. per ton.

Premier Diamond.—As usual, the annual meeting of the Premier Diamond Mining Co. resolved itself into two parts: first, the cold, matter-of-fact statement of T. Cullinan, and second, the volcanic oratory of A. Wagner, whose outburst was designed to exterminate his foes and critics, to terrify the waverers into jumping down precipitously on his side of the fence, and to notify his supporters of the wisdom of their loyalty. Mr. Cullinan was the Chancellor of the Exchequer; Mr. Wagner the Minister of War. The company's reports contain some remarkable figures. The demonstration of a policy of fearlessness through the last two years of trade depression appears forcibly in the total of 15½ million loads (16 cu. ft.) washed during the period. The value per load in 1909 is given at 3s. 1·4d. against 3s. 6·7d. for 1903. Costs have been brought down to 1s. 11·4d. per load, owing to higher efficiency and increased magnitude of operations.

The management of the Premier is fortunately free from criticisms of the new school of mining economists and cannot be accused of attaining these costs at the expense of grade. When the full plant is running, the company will be treating the vast total of 1,000,000 loads per month.

MELBOURNE.

Broken Hill. —The mining world has put its tongue in its cheek over a bit of news flashed from London a few days since. "The reason why Broken Hill shares are depressed is because of the serious nature of the news respecting the Block 10 mine." Of course if people like to put their heads in the sand they will be surprised at what is happening at Block 10 mine. If they have observed the portents of the past two years they must have known what was coming to Block 10, what has happened to Block 14, and what will happen to the South, Central, and the South Blocks in time. The failure of the Broken Hill Proprietary to prove ore at depth in its Block 11 lease meant, as the orebody pitches thence into Block 10, that the vertical limits of the ore has been determined. Another ore-shoot may exist below, and there may be parallel bodies, but they have yet to be found. Failing proof of their existence the mines to the south of Block 11, like Block 10, the Central, the South, and the South Blocks, must, according to the extent of their leases on the strike of the lode, lose the ore-shoot on its southerly pitch. This will happen first at Block 10, as it is next to Block 11. The Central and the South have not developed or worked out the ore in their claims to anything like the same extent as Block 10, and the South Blocks has not got on to the main shoot at all in depth. Nor does anyone know what it will be when opened up. But the plain fact to be borne in mind when studying Broken Hill mining is that the work at the Proprietary has demonstrated the depth to which the shoot of ore that has yielded so much riches in the past goes in that property. The work at depth in Block 10 at a still deeper level has disclosed that the lode there is narrowing rapidly. And as time goes on the keel of the shoot will be reached in the other mines to the south. What may occur to the Junction North and the North cannot yet be foretold as they deal with distinct lenses of ore away to the north. But in the Junction, south of them, the shoot of ore is poor and refractory at depth. They may escape the impoverishment in the value of the ore that has happened in the Junction lease. At present no one can tell whether this is so, because no one knows what was the result of the diamond-drilling done in the North mine. These notes may seem to be pessimistic, but when such news as quoted is cabled to this side of the world it is time that the exact position should be grasped. Everyone on this side imagined that London knew, as well as Melbourne and Adelaide, the position of affairs. Otherwise why should Australian shareholders have let London take from them the big slabs of Block 10 and Block 14 shares that have been sent across the water. The cablegram and the reports that have apparently been circulated in London must be the work of shrewd speculators who have taken up Broken Hill of late. Money can be made in two ways: on the rise or on the fall of the market. The cablegram seems to indicate that one of the weapons in the speculator's armoury is being used for that purpose.

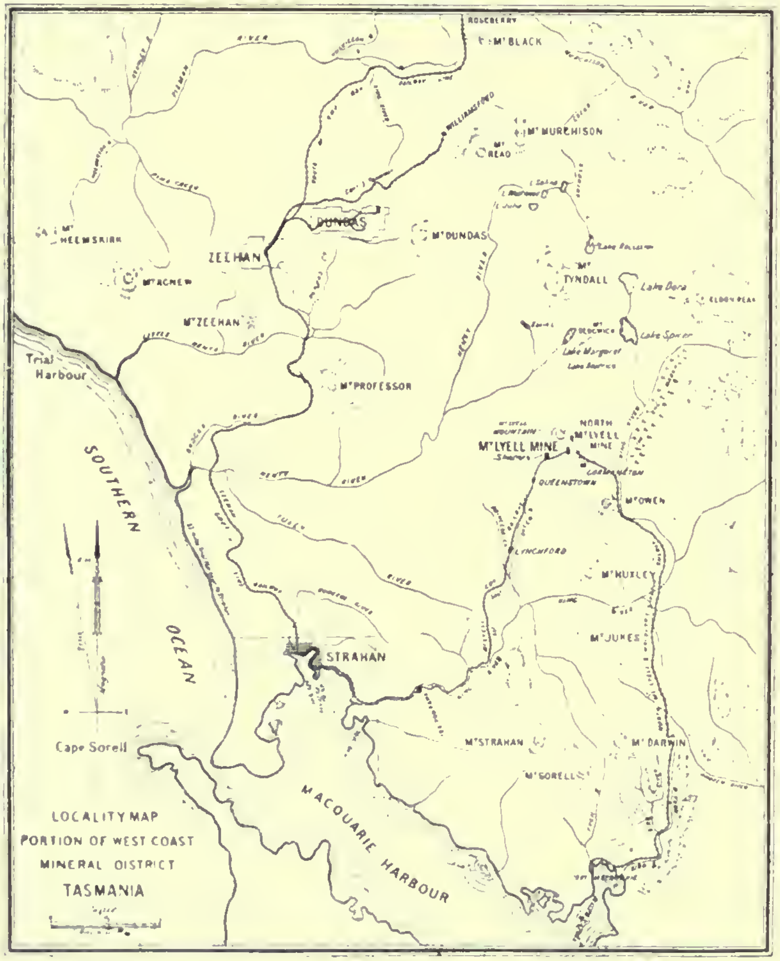
Mr. Govett. —While on Broken Hill affairs the fact can again be gravely stated that Mr. F. A. Govett is among us. Hitherto the West has known him. To the students of human nature here Mr. Govett's evolution as a mining man has escaped close review. But now he is being inspected a la Rabelais. Four days after he reached Broken Hill his first visit there, by the way—he submitted himself to the interviewer and he has been doing the same thing more or less ever since. This may be the way of the London director. Indeed when another star in the firmament in which Mr. Govett moves was here during the deep-lead boom he let himself go in very much the same style. Of course we know that Mr. Govett could not have summed up Broken Hill or even the potentialities of one of its mines in the four days he had spent there. But he had around him mining engineers and directors of companies of various sorts. The deduction drawn is that he got his priming from them. This may be incorrect, but we like to think it so because that would be a tribute to native talent. Anyway the career of Mr. Govett in the Eastern States is giving a fresh interest to life. If he only takes up mines as readily as he speaks, he will have a quiver-full when he leaves these shores. What is most delicious to Australian shareholders of some of the concerns of which Mr. Govett is chairman is the air of proprietorship he adopts in respect to the mines. It is "my mine" or "my company." When Mr. Govett has had some experience of Eastern mining men, the genuine article and not the promoter type, he will discover that the man with 100 shares does not allow any personality to dominate the management of any mining company to his exclusion. This fact is stated plainly because Mr. Govett's speech may be taken more seriously than he intends. The great aim of the Stock Exchanges, the Association of Mining Secretaries, and the Chamber of Mines of Victoria is to wipe out personal rule in the board-room of mining companies. Too many directors want mines to be regarded as "their properties" and "their companies" and reports to be viewed as "their reports" rather than as the reports sent to men having fiduciary responsibilities. So the oracular method of speech of Mr. Govett has to be subjected to a little criticism. If it opens the door more widely to company reform in the direction aimed at, good will come out of his visit, though not perhaps quite in the way in which he contemplated. As far as Broken Hill mining goes, Mr. Govett need not be taken seriously except when he is playing the part of Jacob to the mining Esaus of the Barrier Range.

Mount Bischoff.—Dividends to the extent of £2,000,000 odd is the record of the Mount Bischoff tin mine in North West Tasmania. The property is historical in a double sense. In the first place it was a portion of the grant of 350,000 acres allotted by the Crown in the dim and distant past to the colonizing company known as Van Diemen's Land Co. But as the claim then consisted only of a barren outcrop the surveyors in marking out the area of the concession of the company excised Mount Bischoff. Next it was discovered by a prospector, Philosopher Smith, whose daring and determination sets him at the head of all Australians of his class. I have just been visiting his old haunts and find that his wont was to disappear into the Tasmanian bush with a scanty supply of provisions and then poke about in the dense forests until either driven out by want or he had found some deposit worthy of development. Only those who have been through the Tasmanian bush can realize what Smith's work meant. The 'horizontal' as the jungle is called is abundant in the forest fastnesses. It has to be cut down, or fired, or climbed over. To do the last would mean progressing at the rate of a mile a day. It is always wet and dripping; bird and animal life is rare, and provides little means of sustenance to the prospector. But Smith persevered year after year, often being so weakened by privation that he could hardly reach the first outlying friendly settler's hut. It was because of his philosophy under such circumstances that he received his nickname. His reward was the discovery of the Mount Bischoff mine. Two years ago the claim had as ragged and as forlorn a look as the old prospector prior to his great find. This was because it was believed that the claim was at an end. Now the property is putting on a new lease of life. This is due to the energy and up-to-date skill of the general manager Mr. Millen. The mine has had a complete overhaul and it has been found that with modern appliances and methods of treatment it should have years of work ahead. Directors were somewhat disinclined to face the music when asked by Mr. Millen for the necessary capital, but he eventually got them in the spending mood and the outlook is now for a continuance of dividends for a long time to come. Mr. Millen's trip to Broken Hill was decidedly of advantage in widening his grasp of concentration work and labour-saving methods.

Mount Balfour.—This copper district has sunk back into quietness now that the first blush of its discovery has faded. Two or three companies are doing steady development work out of the scores of mushroom ventures floated. Altogether a length of about 35 miles of quartz and ironstone outcrops were pegged out and now the tap of the hammer is silent on almost the whole of the claims. The best work is being done on the Mount Balfour Mines' and and Mount Balfour Copper Mines' claims. In the former group of properties capital is being spent in shaft-sinking and in the latter adits are being driven to prove the formations at depth. If this work be successful then a fillip will be given to the district. Otherwise the outlook is gloomy.

Mount Read.—In the Mount Read district an interesting discovery has been made on a claim in which English investors are largely interested. A body of ore has been cut in the adit which is being driven by the Tasmanian Copper Co. and the Florence Copper Co. It is hoped that the formations on these claims will prove amenable to treatment by the Horwood process. If so the industry in a neglected district will revive immensely. At the claim close by belonging to Broken Hill Block 10 the Comstock ore has been subjected to treatment by the Horwood process with good results. The next thing is to prove the extent of the deposit.

North Queensland mining is still dull. The Great Fitzroy is in the lingering stage at the present moment. A recent estimate of the ore proved shows that well over 1,000,000 tons is in sight. The average content of the ore remains up to the standard of that already reported in these columns, but some fear is expressed that as the outside shell of self-fluxing ore disappears the treatment of the more silicious material remaining may involve losses that will make the margin between profit and loss very close. Concentration, it is predicted by adverse critics, will entail such a loss of copper and gold as to imperil profits. Bewick, Moreing & Co., the managers, however, are in no way dismayed at either this expression of opinion or at the problem ahead of them. Mr. Mitchell, their superintendent, expresses his belief that the difficulties are not at all comparable to those that had to be faced by the Zinc Corporation. As he is not given to what colonials call 'fluting' the matter rests at that for the time being. The new plant is being erected rapidly, so that practical results will soon determine the future for the Great Fitzroy.



SAN FRANCISCO.

Mergers are promised and threatened in many quarters, but as a matter of fact the successful efforts to consolidate mines are few. The noisiest attempt in this province of mining finance has been that made on the initiative of Daniel Guggenheim, to effect a fusion of the Nevada Consolidated with the Utah Copper. These are both so-called 'disseminated porphyry' copper deposits, extremely low in grade, as judged by the standards of a decade ago, but capable of yielding a fair profit with copper selling at the prices that have prevailed for the past year. The effect of the merger, however, would apparently not be to give mutual strength and increased economy in operation to both corporations. It was proposed to exchange $2\frac{1}{4}$ shares of Nevada Consolidated for 1 share of Utah Copper Co.'s stock. The Nevada Consolidated has a supposed total earning power, at present prices for copper, of between $50,000,000 and $60,000,000. The capitalization is $10,000,000, divided into $5 shares, which represent a market value, at current quotations, of about $49,500,000. The ore reserves, as proved to date, amount to about 30,000,000 tons, and the recovery is 33 lb. copper per ton, at a total cost for refined copper delivered at Atlantic tide-water of about 7 cents per pound. As low a cost as $6\frac{1}{2}$ c. is claimed. The Nevada Con. owns copper-bearing territory in addition to that containing the abovementioned tonnage, but the deposits are covered by a greater depth of overburden, and manifestly cannot be worked at as low a cost as the ore now being mined by steam-shovels at Copper Flat. The facilities for ore-treatment are so well known as to require only passing mention. The company's magnificent concentrating and smelting plants represent the highest state of the metallurgic art, and now have a capacity of 6000 tons of ore per day. The control of the railroad from the mines through the town of Ely to the works at Steptoe, and thence to the main line of the Central Pacific, gives it a tremendous advantage in transportation costs.

Utah Copper reserves are not so well known to the public. The president, Charles M. MacNeill, claims over 100,000,000 tons, while James Phillips, Jr., president of the Nevada Con. concedes over 40,000,000 as being definitely proved. Here also, the most cheaply accessible ore is being extracted, and the costs of mining will manifestly increase as the workings extend up the east side of Bingham canyon. The monzonite porphyry has been eroded by the drainage of Bingham creek, and the zone of secondary enrichment, constituting commercial ore, conforms underground to the topography. The canyon is deep and precipitous; therefore the angle of rise of the orebody is sharp, and this imposes difficulty in mining. Among other things it renders it impossible to strip the overburden without leaving remnants of the barren rock, and in excavating the ore with steam-shovels it is equally difficult to avoid cutting deeper than the limit of 'commercial ore' at the angles of the successive steps or benches. The Utah Copper is now milling about 8000 tons of ore per diem. Its costs have been declared by outside parties, who are well informed, to be approximately 10 cents per pound. The company owns its mill at Garfield, but delivers its concentrate under contract to the Garfield smelter of the American Smelting & Refining Co. The position of the Utah Copper has been materially strengthened by the absorption of the Boston Consolidated mines and mill, which not only gives it increased tonnage, including some high-grade sulphide ore, but also simplifies the problem of mining, which was serious while the monzonite deposit was bisected on the steep canyon-side by the boundary line between the two properties.

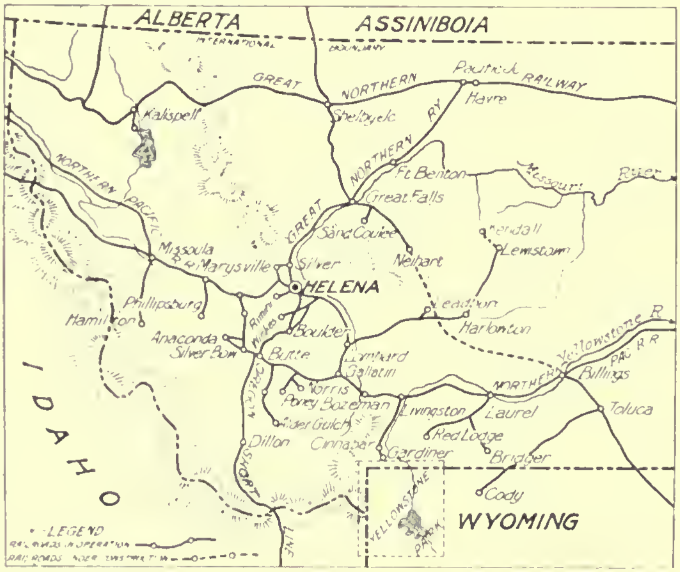
Nevada Consolidated has been benefited only in a negative manner by its recent absorption of the Cumberland-Ely. The latter property is understood to have become too expensive to operate, and it is freely said that advantage was taken of labour troubles to close the Veteran mine. The Cumberland-Ely, however, owned half of the railroad and reduction works, and the contract between it and the Nevada Con. entitled either party to utilize any part of the capacity of these works which the other could not employ for its own products, on paying 7% on the corresponding proportion of the capital invested in the plant. This valuable privilege was coveted by the Cole-Ryan people, who had recently bought the Giroux mines, lying between Copper Flat and the Veteran mine. To prevent an unsought alliance through the threatened acquisition of the Cumberland-Ely by the Giroux company, the Nevada Con. added the Cumberland-Ely to its holdings.

The effort to consolidate the Nevada Consolidated with the Utah Copper has led to a warfare of abuse in letters and circulars issued by both sides, charging misrepresentation and bad faith. In spite of the lack of definite information as to the costs of production and the physical assets of the Utah Copper, the merger fell only 50,000 shares short of being accomplished, 953,000 shares of Nevada Con. having been offered for exchange on the basis proposed by the Utah Copper Company.

Ely Central.—A tumult of abuse has also been in progress over the Ely Central, a property lying between the Copper Flat and Ruth mines of the Nevada Con. It is not improbable that life-long enmities have been occasioned by this broil. The methods utilized for financing the Ely Central have been of a sort that are generally condemned. Questions of fact concerning the mine, however, are different. The critics of the Ely Central denied the existence of important workable orebodies in its ground. Subsequent investigation by C. S. Herzig, followed by an examination by Walter Harvey Weed, indicate that ore does exist, with indications that are taken as being quite favourable for a large deposit. Rumours have been circulated to the effect that the Guggenheim interests were cognizant of the prospects of finding valuable deposits on Ely Central property, and that they had an eye to a possible absorption of the company on favourable terms. This would give the Nevada Con. a solid block of ground from the Giroux boundary across to the Ruth mine. It is surprising that the watchful and aggressive Guggenheims allowed the Cole-Ryan people to maintain the cleavage between the Veteran mine and Copper Flat by acquiring the Giroux. There is evidently a large amount of ore, of a copper tenor higher than usual, among the Ely properties in the Giroux mines.

Anaconda.—Another great merger, which has long been foreseen, is that dated for March 23, when the Anaconda Copper Co. will absorb the Butte mines of the Amalgamated, historically both famous and infamous. It is generally supposed that North Butte and Tuolumne will also be included in the merger. Consolidation in this case means reduction of operating cost, facilitated by the locality of the mines. Additional connections in Butte, leading to a formerly elusive harmony, may be announced as a result of the negotiations now pending.

The Comstock.—Perhaps the most generally attractive proposal for a mine-consolidation is that recently made by Franklin Leonard, Jr., for a union under a single holding company of the mines on the Comstock lode, in Nevada. Under the old regulations the mining claims of this world-famous bonanza were limited to 100 ft. on the outcrop. Many of these were early absorbed into groups of such size as to admit of mining on a rational basis. This was well enough while the mines were shallow, but in depth great difficulties were experienced from enormous volumes of hot water, often reaching a temperature of 170°F., while the air in the stopes would be as hot as 150°. The water could with extreme difficulty be kept from invading the whole group of mines, and combinations for pumping and ventilating have been proposed, and, in an ineffective manner, undertaken in the past. The Comstock mines, however, were operated for years as a basis for stock gambling of the most nefarious sort, the feeble and temporary successes being utilized to boost the price of stock, which would then be depressed by the 'ring' through the levying of assessments, ostensibly for betterments above or below ground. The game of shuttle-cock was maintained for decades, until the very name of Comstock became a reproach in the mining world. The method of exploration for bonanza orebodies, on which the discovery of ore at the Comstock has always depended, has not been eminently profitable. Recently development in the Mexican mine has been carried forward under the intelligent direction of Whitman Symmes, who has discovered orebodies of value lying outside the supposed limits of the lode, but precisely where geological reasoning would indicate its existence, namely at the intersection of related zones of shearing. This opens new possibilities for the future. Mr. Symmes has successfully handled the outbursts of heated waters, and has been able to reduce the temperature of the workings so that men can remain on duty through normal shifts. The latter has resulted in the costs of mining being reduced fully one half. Encouraged by this work Mr. Leonard has succeeded in interesting a group of the best known financiers of the country, including Adolph Lewisohn, New York; Ernst Thalmann, of Ladenburg, Thalmann & Co., New York; A. L. Scheuer, of Probst, Wetzlar & Co., New York; Charles A. Ellis, of Lee, Higginson & Co., Boston; B. F. Shaw, of Shaw Brothers, W. C. Ralston, and James McNab, of McNab & Smith, San Francisco; and the well known J. Parke Channing, so long identified with large copper operations East and West. Franklin Leonard, Jr., controls the Sutro tunnel, which unwaters the Comstock Lode to a depth of 1600 ft. below the outcrop, and he also owns a controlling interest in several mines on the Lode. Through his efforts a syndicate was formed by the persons named above, which for a considerable period purchased floating shares in the several Comstock mines. When sufficiently strong to feel assured of success it suggested a consolidation which bids fair to secure co-operation from the majority of outside holdings. The Crocker National Bank of San Francisco, and the Bankers' Trust Co. of New York, are named as depositories for stock in the Comstock mines; deposits may be made up to April



Montana.

15, and negotiable receipts will be issued, so that no depositor will lose the opportunity to realize upon his stock at any time. The syndicate will announce its plan of consolidation to the depositors at some date between April 15 and August 1. The stockholders choosing to reject the proposal then made may withdraw at any time within 30 days after such announcement, without having incurred any expense on account of the deposit. To name the mines now expected to be included would be to name them all. It seems certain that the groups at both the north and south ends of the lode will be involved. Only a few mines between, controlled by the Morrow interests, are at present uncertain. It is probable that the stock of those companies will also be deposited, since doing so does not commit the depositor to acceptance of the terms offered, while it places him in position to profit by such advantages as may be expected to accrue to participants at the time of consolidation. The conclusion of this merger would revive mining on a great scale, and elevate the Comstock above Pachuca as an object of interest in the mining world. It is proposed to hoist the ore to the Sutro tunnel level, and tram it out four miles to a large mill to be erected. The improved metallurgic processes, particularly the adaptation of cyanidation by Charles Butters at the Virginia City plant, will have great influence on the future treatment.

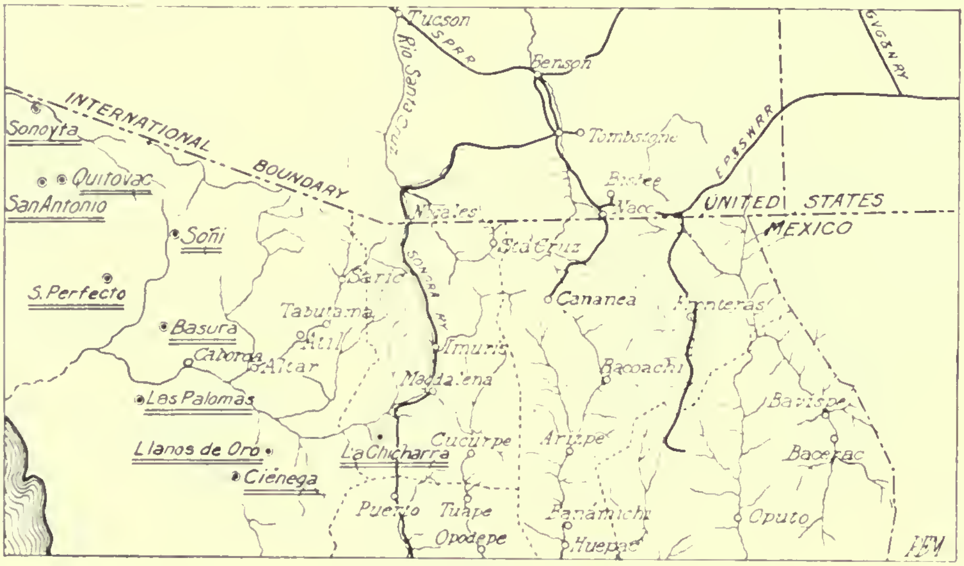
Arizona.—A consolidation of the Ray, Gila, and Chino mines in Arizona is likewise mentioned as in prospect. These properties are controlled by the same group of men who dominate the Utah Copper. The Chino mine, which is in fact a group of related veins, situated at Santa Rita, New Mexico, was the subject of a remarkable effort at promotion last year by Thomas W. Lawson. The death of Henry H. Rogers at this juncture prevented delivery of stock, and the transaction was abandoned after costly advertising. The public was thus undoubtedly spared another fleecing such as attended the Lawson promotions of Amalgamated Copper and Yukon Gold. Like those enterprises, there was a sound basis underneath, and Chino is confidently expected to become a producer of the first magnitude. Moreover, no fanciful new processes will be required, as proposed by Mr. Lawson. In the hands of reputable engineers and metallurgists, conventional proved methods are deemed quite sufficient. It is said that 14,000,000 tons of 3% ore have been proved on this property. The Gila, which adjoins the Ray copper mine in the Miami belt near Globe, Arizona, is also reputed to have a demonstrated reserve of 14,000,000 tons assaying $2\frac{1}{4}$%. This group of three properties it is now assumed will be combined under a single administration. R. C. Gemmell, assistant to D. C. Jackling of the Utah Copper, is spending much of his time at these southern properties, being relieved in the discharge of his duties in Utah by the addition of Louis S. Cates to the staff. Mr. Cates was formerly mine superintendent for the Boston Con. These changes in administration are thought to forestall a larger burden of responsibility for Mr. Jackling, who may become consulting engineer for the Guggenheim properties in the United States, Alaska, and Mexico.

In California the smelter fume trouble in Shasta county seems to be definitely ended by a contract between the Farmers' Protective Association and the Mammoth Copper Co., a subsidiary of the United States Smelting, Refining & Mining Co. The decree handed down by Judge J. A. Marshall of Utah, in the smoke cases at Salt Lake, has been accepted as the basis of agreement. This requires the condensation of the sulphuric anhydride and its filtration from the gases in a bag-house. The condensation is effected partly by cooling and partly by neutralization, zinc oxide (produced by burning zinc ores on a grate with coal), and quicklime, being employed for this purpose, although the contract specifies zinc oxide "and other substances." The amount of SO_2 permitted in the escaping gases is also limited to 0·75% by volume. The Balaklala smelter is installing the F. G. Cottrell electro-static precipitation process, which has worked well on the SO_3 issuing from the sulphuric acid silver-refinery of the Selby smelter on San Francisco Bay. The fume-case at Anaconda, Montana (Bliss *v.* Anaconda) which was decided by Judge William H. Hunt last year in favour of the smelter has been appealed, and it will be argued in the 9th Circuit of the Circuit Court of Appeals, in San Francisco. There will be 60 printed volumes of testimony, taken at the former trials, presented for review at the hearing in this city. Included in this are the statements of the most eminent chemists and metallurgists in the world on the composition and control of smelter fume. Nowhere else has so much technical information on the subject been collected. An abstract of this testimony will prove of universal interest and of immense value to metallurgists.

The old copper property at Copperopolis, Calaveras county, California, chiefly owned, under the title of the Union Copper Co., by the Ames estate of Boston, has been reorganized as the Calaveras Copper Co. The mill of 300 tons capacity, is to be enlarged by J. H. Tresise, the manager, to a capacity of 600 tons daily, a 250-ton blast-furnace will be erected in addition to the 125-ton reverberatory, now available, and two stands of converters will be provided. The company is looking for a local market for its output, as casting copper. If it succeed in disposing of its product on this coast the matter will be of great interest. Transportation rates have been so adjusted in the past as to compel shipment of west-coast copper to Eastern markets, aside from the absence of refinery facilities on Pacific tidewater. With the increasing development of water-power on the Pacific slope, however, refining here would seem to be not altogether beyond possibility.

MEXICO.

Patent laws.—The new Mexican code of mining laws has only recently been put into force, and now it is announced that the patent laws are to receive similar attention; in the course of a few months they will be completely revised. Many improvements upon the existing laws are under consideration, with a view to obtaining clearer definitions with less useless verbiage in applications, more careful and technical examination as to the novelty and usefulness of new patents, and a consequent better guarantee of the validity and security of the title to the patent when finally granted. As most of the patents applied for and granted by the Mexican Patent-Office pertain to the mining and metallurgical industry, any improvement in the law will be welcomed by mining men generally; for great confusion exists respecting the validity of patents upon many devices at present in use, especially in plants for treating gold and silver ores. It is, of course, to be expected that a country of such recent industrial growth as Mexico should be behindhand in legislation affecting these matters. On the other hand, a country untrammelled by the weight of established precedents can frame laws along entirely new lines, taking advantage of the complicated experiences of the older countries. An instance of this is to be seen in the mining laws of Mexico, which are perhaps the most equitable in the world. They were made by miners for miners, and not for lawyers. The latter reproach would seem to attach itself to most patent laws, not to those of Mexico alone; for more money is undoubtedly made by lawyers, in lawsuits upon the validity of patents, than is ever made by the patentees themselves. The Patent-Office of Mexico at present is chiefly administrative and the technical examination of patent applications leaves much to be desired.



STATE OF SONORA, MEXICO.

Sonora.—From the old Altar mining district in this State, not far from the boundary between Mexico and the United States, comes the news of an important gold discovery and of a big rush to the district. This was an important goldfield in the 18th century when the

Spaniards worked the mines, and during that period of activity millions of dollars worth of gold were recovered by crude methods. Sonora is an important mining region, but the difficulties with Indians, lack of railroad facilities, and similar inconveniences have greatly retarded progress. With the improved railroad conditions offered by the Southern Pacific, and the rapid development of cyanidation for the treatment of low-grade ores, there is no doubt that the next few years will witness a great expansion in the gold production of the State.

Pachuca.—This district is the centre of mining interest in Mexico at the present time. The purchase of the Santa Gertrudis properties by the Camp Bird company for approximately £900,000 is an adequate reason for this. While this somewhat spectacular deal has proved a great advertisement for the district, the real reason for the notable expansion in the last few years has been the successful application of the cyanide process to the treatment of silver ores. Five years ago the district was almost dead, and only in 1906 was cyanide treatment attempted in earnest, after the process had proved so successful upon similar ores at Guanajuato. There are now six large modern cyanide plants of a total capacity of 1500 tons per day, and the companies owning them are making large profits. The rehabilitation of the mines and their transformation into large producers is entirely due to the introduction of cyanidation in the first instance. Previously the high cost of treatment by the old Patio process, as also the increasing cost of deep mining by old methods, had gradually diminished the profits obtained till only a few mines survived. General stagnation prevailed. The introduction of cyanidation more than halved the cost of treatment and gave a better general extraction. The introduction of up-to-date mining machinery, and cheap electric power quickly following, soon created a general revival, and there is no doubt that Pachuca is now only at the beginning of an era of greater prosperity. Several of the cyanide plants are of the most efficient type, and include the most modern improvements. The Pachuca tank is in general use, except in the Real del Monte plant, which were erected before its introduction; it has proved to be the best agitator yet invented for obtaining a thorough contact of the slimed ore with the cyanide solution.

Real del Monte.—This is a very old mining centre and forms part of the Pachuca district. The town of Real del Monte is 6 miles from the town of Pachuca. It has been a famous silver producer for more than 300 years, being one of the first districts worked by the Spaniards. The veins are traceable in some instances for 15 kilometres on the surface, and are unusually wide. The most important, the Viscaina vein, is of an average width of 5 metres and in many parts is as much as 12 to 15 metres wide. There are two systems of parallel veins, one of Pachuca proper, a north-south system, and the other of Real del Monte, an east-west system. The former of the two systems has been the most productive to date. Deeper exploration has given excellent results, showing that the rich ore persists in depth. The deepest workings are those of the Santa Gertrudis; they reach to 420 metres, and at that depth are in ore as good as was found in the shallow workings. There are several old mines still working under old methods and capable of similar re-organization and expansion. Portions of the district are still virgin or only superficially worked.

Zacatecas, another old mining camp famous for silver, is again beginning to come to the front. Two new plants are being erected, following upon the installation of a large 300-ton cyanide plant at the Bote mine, owned by an English company that has been in most successful operation now for nearly one year. One of these new plants is a custom mill in the town of Zacatecas, and the other is at the Veta Grande mine a few miles from the town. The old Veta Grande mines, which were great producers in olden times, have been closed down for many years. They contain a large tonnage of old filling, of a grade of 700 grammes silver per ton; such ore can now be worked profitably by cyanidation. The successful introduction of the cyanide process into Zacatecas is destined to produce another revival, similar to that at Guanajuato and Pachuca.

LIMA.

Steamship Lines.—The new line called the Compania Peruana de Vapores y Dique has begun its schedule after several months of delay. The two steamers now in use are of 3000 tons capacity and well equipped for passenger service; they use oil as fuel and can make 18 to 19 knots per hour. Six more boats are stated to be in course of construction. This service will result in quick passenger-transit and mail-delivery between Peru and the United States and Europe occupying 11 to 16 days respectively from Callao, if good connections are made throughout. It is reported that the Kosmos line will also enter Panama; thus four steamship lines will be in competition between the two ports as against the two that have controlled the situation for years. No doubt lower freight-rates will result, as well as an improved service.

Cerro de Pasco.—Despite the exceptionally dry season, causing scarcity of water for smelting and consequent curtailing of operations, the monthly output since October 1 has averaged nearly 3,000,000 pounds of copper. The wet season has finally commenced so that the water famine is ended. The lack of sufficient McDougal roasters, which will be installed shortly, has prevented the use of all five reverberatories. The smelter, however, is able to produce copper at the rate of 5,000,000 pounds per month despite these restrictions. Four additional McDougal furnaces have been ordered and it is probable that the six converters now in operation will be added so as to bring the plant up to its full capacity. The record, for a single day, was made on February 9, when 187,113 pounds of copper were produced. The coal-washing plant has been improved and a better class of washed product is obtained for the coke-ovens, thereby making it possible to produce a more cellular and stronger coke. About 4000 tons of coke is produced per month, that is, a daily output of from 30 to 40 tons of coke above the blast-furnace requirements. The better results obtained in washing the coal has been due to the use of a Robinson tub washer, of 400 tons capacity, replacing the jigs.

The 40-stamp mill of the new Chuquitambo Gold Mines Ltd. continues to produce from 9 to 10 kilogrammes of gold per month from an average of 2000 tons of ore milled. Possibly 50% of the gold in the ore is run off in the tailing, as the only extraction is on the amalgamating plates.

Coal Mining.—In the latter part of January a coal-dust explosion occurred in the lower workings of the Goyllarisquisga coal mine resulting in 29 men being killed. The mine makes no gas but in parts is quite dry, so that tamping the holes with wet clay is practiced. One result of this accident has been the framing of a new series of coal mining laws, which apply almost entirely to gassy mines. The coal industry in Peru is in its infancy, and no gassy mines have been opened up so far. The Goyllarisquisga mine is the deepest and the only developed mine in the country, the incline being 2600 ft. long and about 1500 ft. vertical. A cross-cut adit is being driven to cut the seam at nearly 3000 ft. on the dip, and serve for drainage as well as ventilation; about six-tenths, or 1800 ft., is already bored.

The Morococha district is producing 2000 tons of ore monthly, chiefly from the Natividad, San Francisco, and Maria mines. Half of the output, about 500 tons, from the first mentioned mine goes to the Casapalca smelter, and averages 16% copper and 14 oz. silver. The smelter is owned by the Backus & Johnson Co., which controls half of the mine, the other part being owned by the Morococha Mining Co. The Maria mine is shipping about 300 tons of ore, averaging 13% copper and 40 oz. silver. On February 1 a shipment of 6000 tons of ore, principally from the Morococha Mining Co.'s mines was sent in bags, in one cargo to New York by the straits of Magellan; this is probably the largest single shipment of ore that has ever been made on the west coast. The Backus & Johnson Co. has entered upon a new era of prosperity not only in obtaining better results in smelting, producing about 20 tons of matte daily from 100 tons of copper, but in finding good ore in the Carmen cross-cut. After five years of patient work

the vein was cut, producing a flow of water so heavy as almost to prove disastrous to the plant at the mouth of the adit. Pieces of ore washed out have given assays of from 3 to 4% copper and 150 to 200 oz. silver. About 200 metres vertical of virgin ground has been made available, thus assuring the smelting of a class of ore that will permit of smoother running of the furnace and not necessitate the purchase of outside ores.

New Railways.—The survey of the narrow-gauge railway for the American Vanadium Co. has shown that about 55 kilometres of track will be necessary from the mines to the Cerro de Pasco railroad. Most of the grading would be over easy ground, and only that part near the mines would be in rock. It is probable that about £125,000 is necessary for the grading. The Chimbote-Recuay railroad has laid tracks up to 100 kilometres and it is expected that 105 kilometres will be reached in a few weeks. The heaviest part of the work will begin in entering the Canon de Pato. It is of interest to note that the line from Chimbote to Tablones, formerly operated by the Peruvian Corporation, has been acquired by this company.

Later News. — The Huaracaca smelter, near Cerro de Pasco, which belongs to E. E. Fernandini, will soon be doubled, thus bringing its capacity up to 150 tons of ore per day. Of the ore treated 95% comes from the Colquijirca mine and averages about 65 oz. silver, 10% lead, and 5% copper; the resulting matte averages about 1500 oz. silver and 55% copper.

The Cerro de Pasco company's production for February amounted to 4,070,000 lb. of copper and the indications for March, at the present rate of output, are that 5,000,000 lb. may be reached. The mines are shipping nearly 1000 tons of ore per day to the smelter.

The Inambari Gold Dredging Company expects to begin operations in July, barring unforeseen delays. The 5-ft. dredge will probably handle 1200 cu. yd. per day and commence digging in the easier ground; the experience of endeavouring to handle that part of the concession where many boulders exist proved a costly one, as the first dredge sank before it had made a start, owing to an unexpected rise of the river. The success of the present campaign will mean much to that part of the country, as it is a new departure. The question of transporting the various parts of the machinery over 164 miles of wagon-road, mule-path, and trail seems to have been successfully accomplished without loss of parts and at a fairly low cost, £1 per 100 pounds.

TORONTO.

Canadian Mining Institute.—The twelfth annual meeting of the Institute was held at Toronto on March 2. A large number attended. Dr. Willett G. Miller, the president, occupied the chair and delivered a comprehensive inaugural address, reviewing the history and work of the Institute and the present condition and prospects of the mining and metallurgical industries. He suggested several changes in the mining laws, more particularly the substitution of an acreage tax for work obligations as a means of preventing the holding of undeveloped locations for speculative purposes. The report of the council showed an increase in membership, the total number being 935.

Mineral Production.—The preliminary report of the Canadian Department of Mines on the mineral production of Canada during 1909 was presented, showing the value of metallic products as $45,188,387; non-metallic $44,927,376; estimated value of products not reported $300,000; total $90,415,763. Compared with the total value for 1908, which was $85,927,802, this gives an increase of a little over 5%. The metals nearly all showed an increased output. The list is headed by silver, which was produced to the amount of 27,878,590 oz. valued at $14,358,310. The total silver content of ores, concentrates, and bullion shipped from the Cobalt mines was 26,364,703 oz. Gold production showed a slight fall, the preliminary estimate giving a value of $9,790,000. Other items are copper 54,061,106 lb., value $7,018,213; nickel 26,282,991 lb., value $9,461,877; pig iron from Canadian ore 149,444 tons, value $2,222,215; and lead 45,857,424 lb., value $1,959,488. Coal was produced to the amount of 10,411,955 tons, valued at $24,431,351, the production showing a decrease as compared with the two preceding years; the drop in the output of Nova Scotia, caused by the miners' strike, amounted to 968,789 tons, and was not compensated by the increase in the yield of the western provinces. The total production of coke was 875,080 tons, valued at $3,557,147, being a slight increase. Returns from eight steel plants indicated a considerable expansion in this industry, the total production of ingots and castings being 754,719 tons, valued at $14,359,710, as against 588,763 tons, valued at $10,916,602 in 1908.

Mining Practice Criticized.—The feature of the meeting which attracted most attention and has since given rise to acrimonious controversy was the passing by a small majority of a resolution censuring Mr. Clifford Sifton, chairman of the Canadian Conservation Commission, for having publicly made statements reflecting upon the practices of Canadian mining and metallurgical companies. The offending statements were to the effect that there was too much waste in the handling of raw material, and that the deaths from mining accidents were at a higher rate than in any other country. Mr. Sifton was not without defenders, who retorted that he procured his information about mining fatalities from the reports of the Ontario Bureau of Mines, and was not to blame if these official statements were misleading. At a later session a motion for re-consideration was hotly debated, but no further action was taken.

Cobalt.—With the arrival of cheap power in this district the economic conditions are decidedly improved; there is now every prospect of an active season and greatly increased shipments. There are two power companies in the field, the Cobalt Power Co., which is delivering power only in small quantities at present, from Ragged Chutes on the Montreal river, but will increase its deliveries before long; and the Mines Power Co., which is generating electric current at the Matabetchouan Falls. The latter will have two stations at Cobalt for compressing air which will be sent by pipe to the mines, and in addition it has installed a system for the distribution of power by electricity. Contracts for a supply have been made with a number of companies, with a penalty for failure to deliver at the specified time. As the price will be only about one-half the cost of production by individual plants, an opportunity will be given to develop or work many mines that have for some time been inactive. The revival of public interest begins to be reflected in the stock market, where the cheaper issues are coming into favour. Several, which are regarded as coming dividend - payers, including Cobalt Lake, Peterson Lake, and Beaver, have lately been slowly advancing in price. The higher priced stocks have not shown so much movement, but remain firm.

Ore Shipments from Cobalt were well maintained during February, the total being 2276 tons, as compared with 2115 tons for February 1909. The total shipments for January and February were 4304 tons, as against 4528 for the corresponding months of last year. The La Rose headed the list for January and February with 933 tons, Nipissing taking second place with 793 tons. La Rose has struck a new ore-shoot in a rise from the 135 ft. level on No. 3, and driving for 50 ft. shows an average width of 4 to 5 in. of high-grade ore. At the Temiskaming rich ore has been found at the bottom of the shaft at 425 ft., which is, with one exception, the deepest working in the district. The Cobalt Lake Co. is applying to the Legislature for power to reduce its extravagantly high capitalization from $5,000,000 to $3,500,000, hoping to be able eventually to pay dividends on the latter figure. It is proposed to buy on the market enough shares to make the reduction and to cancel them. The annual report showed a loss of $41,906 on the year's operations, but recent discoveries of rich ore led to hopes of a better showing in future. At the Nipissing, large quantities of high-grade ore are being blocked out on the Meyer, Fourth of July, and No. 100 veins. The Meyer shaft is down 100 ft.; on the 75 ft. level the ore runs as high as 9000 oz. in places. The first and second levels on the Fourth of July are being connected with rises. A depth of 300 ft. has been reached on vein No. 64, at which high-grade ore is found. Connections are being made between the two lower levels preparatory to stoping, and large quantities of milling ore are being added to the reserve in addition to the high-grade. At the Hargrave, No. 1 vein, a continuation of the Jacobs vein, of Kerr Lake, has been cut at the 375 ft. level at a distance of 40 ft. from the Kerr Lake line, and on being followed was found to carry rich ore all the way. The Gifford has struck a 3 in. calcite vein well mineralized at the 200 ft. level.

The Prospector.

In the Gowganda district there is much activity in development: plants have been recently installed or ordered on several of the properties, including the Welch, the Ottawa-Gowganda, the La Brick, the Transcontinental and the Calcyte. Numerous shipments are promised in the near future, but so far the only mine to ship steadily has been the Blackburn or Millerett which has made shipments since January 1 amounting to 191 tons.

The Porcupine district has made its first shipment of ore, Timmins Bros., who are operating the Hollinger property, having recently consigned six tons of high-grade ore to the School of Mines at Kingston. There has latterly been a reaction in the excitement over Porcupine, since it has become more generally realized that it cannot possibly be a second Cobalt where cheap and crude methods will pay from the start but that large capital and expensive machinery will be necessary before operations can prove remunerative. The Provincial Government has announced its intention of extending the Temiskaming & Northern Railway into Whitney and Tisdale townships so as to aid in developing the district.

Bear River.—D. D. Mann, of Toronto, vice-president of the Canadian Northern Railway, in association with a number of American and Canadian capitalists, has bought the control of 4368 acres of mining land along the Bear River in British Columbia, north of Prince Rupert and the main line of the Grand Trunk Pacific Railway. It is rich in gold, silver, and lead, with some copper. A large amount has already been expended by the syndicate and arrangements have been made for the construction of a railway to the property from Stewart, the head of navigation on the Portland Canal. A smelter site has been prepared, and it is expected that the district will become important.

CAMBORNE.

Phœnix.—The new main shaft which measures 19 ft. by 9 ft. outside timbers is being sunk steadily and is now down nearly 700 ft. from surface. The Seccombe and Stone shafts have been put in order to the adit level, and when the main shaft taps the water in the old mine, they will be repaired as the water goes down. At Seccombe's a Robey hoist has been installed and head-gears are now being erected over both shafts. A large engine, which is to drive the battery, has been purchased at second-hand and is on the mine awaiting erection. The foundations of the mill are now being excavated.

Wheal Commerce.—This property has been closed, and the machinery, plant, and buildings were sold by auction on April 5 and 6. Here is an instance of the cart being put before the horse, as referred to in last month's notes. A large and well-equipped mill was erected before such an expense was warranted and before any reserve of ore was blocked out. This mill has only run spasmodically, but the product has always fetched a high price.

East Pool & Agar.—The accounts of this company for the 24 weeks ending March 10 showed the heavy loss of £6466 and a call of 22s. 6d. was made to clear the books. The total cost for the period was £34,180 and the receipts £27,714, the difference being equal to a loss of 4s. 4d. per ton on the 29,847 tons milled. The development work was 1113 ft. or one foot for every 27 tons crushed, this being a slight improvement over the last figures issued, when the ratio was 1 : 30. The value of the ore increased from 16s. 3¾d. to 18s. 7d. per ton, but this improvement is solely due to the enhanced price received from the tin and wolfram. It was made clear at the meeting that if the mine is to be operated, a large sum of money must be provided adequately to develop the combined setts and to make various other changes and improvements in their equipment. Capt. Jennings estimates that £11,814 will be sufficient for this, made up as follows: £2500 in enlarging Agar pitwork and unwatering that mine to the bottom, thus making it possible to stop the East Pool pumping-engine, £2700 in duplicating the compressor plant, £4040 in development, and £2574 on surface improvements. He further estimates that this expenditure would enable the company to produce and treat 85,000 tons of ore per annum, and should result in profits of from £7500 to £8500 per annum, based on black tin at £80 per ton. To secure this capital it is proposed to convert the present cost-book company into one of limited liability with a nominal capital of £75,000, divided into 50,000 ordinary and 25,000 6% preference shares; each holder of one share in the present company to be entitled to four fully paid ordinary shares in the new company conditional upon his taking one preference share for each share held in the present company, in which case a fully-paid ordinary share would be issued as a bonus. This, if carried out, would provide £6400; and it is further proposed to issue 15,000 preference shares with one ordinary share as bonus for each preference share issued. If all these shares were placed, it would provide another £15,000, so that the working capital would be £21,400 in all. It is a pity that the developments were neglected while good profits were being made a few years ago, and that the reserve fund of £9000 was expended on dressing-plant. This is yet another instance of the cart being put before the horse.

Wheal Kitty.—This company reports that the Stamps lode has been intersected by Sara's Shaft referred to in last month's notes. The lode is 16 in. wide and averages 140 lbs. per ton.

Levant.—The result of the 16 weeks working ending February 19 last, in view of the anticipations held out at the previous meeting, was disappointing seeing that a loss of £1097 was shown. In explanation of this unexpected deficit the Chairman (Mr. Freethy Oats, son of the Chairman of De Beers) stated that there had been a fall in the average produce, and also a shortage of men owing to an epidemic of influenza. The quantity of ore sent to the stamps was 7242 tons, total receipts were £11,236 or 31s. per ton stamped, and the expenditure £12,333 or 34s., the loss being equal to 3s. per ton stamped. The developments in the lower levels have proved disappointing so far and with such small lodes and heavy expenses, together with the shortage in labour supply, the outlook is not cheerful. The question of lords' dues was again raised and it was unanimously resolved by the shareholders present at the meeting to approach the lords with a request to remit all dues whilst calls are being made.

NEW YORK.

Anaconda.—The most recent news of importance here relates to the merger of the copper mines of Butte and the Granby disclosures. Other matters have been of secondary interest. The meeting of the Anaconda company to authorize an increase of the capital stock from 1,200,000 shares to 6,000,000 shares of a par value of $25, has been held, and the shareholders voted unanimously in favour of the directors' plan. The Amalgamated has laid bare its financial condition by filing with the governors of the Stock Exchange a statement showing its holdings. A committee consisting of B. B. Thayer, Hermann A. Keller, and Otto Sussmann, have inspected the various properties at Butte, valued them, and fixed the ratio of exchange in terms of new Anaconda stock. The meetings of the shareholders of the different companies are at this writing being held, and it is presumed that no obstacle will arise to complete the merger. The Boston & Montana shareholders have already approved; others will follow. The Boston & Montana is alloted 1,200,000 shares of new Anaconda, so that the present holders will get eight for one. Butte & Boston gets 1½ Anaconda for one of its own shares. Washoe Copper gets 380,000 shares; Trenton 120,000 shares; Big Black Foot Lumber Co. 300,000 shares; the Parrot 90,000 shares: Diamond Coal & Coke 100,000 shares; Red Metal Mining 500,000 shares; Alice 30,000 shares. The Amalgamated Copper Co. is the owner of the large majority of the shares of all of the above companies, except Red Metal Mining, which is the title-holding company for Butte Coalition. The holder of 100 shares of Butte Coalition will get 52 shares of Anaconda. The combined production of these various Butte mines is something more than 250,000,000 lb. copper annually. The merger will permit of this metal being produced at a cost of about 9 cents per pound. A fair estimate of the new company's copper on hand and cash, is $25,000,000. The Anaconda is a Montana corporation; no anti-trust decision under the Interstate Commerce laws can possibly affect it, because all of its business is carried on within the State of Montana. Adding the total number of new Anaconda shares received by Amalgamated for its holdings in Butte, it will be seen that there are just about two shares of new Anaconda stock for each share of Amalgamated outstanding. Curiously, Amalgamated has been selling in the open market around 79 and Anaconda around 49. This disparity in price is one of the mysteries of Wall Street.

Granby.—Otto Sussmann, after an examination of the Granby, has reported that the available ore reserves amount to about six million tons. Previous reports by other engineers were to the effect that the Granby had reserves

On the Curb, New York.

enough for many years to come. The Granby company has recently increased its smelter capacity, and on the basis of Mr. Sussmann's statement, the ore available is now only enough for four years. These disclosures caused a tremendous tumble in the stock, both on the Boston and New York exchanges, the shares coming down from approximately 125 to below 40. The prominence and respectability of the interests in charge of the operations gives the matter an air of scandal. The mines, which are in British Columbia, close to the American boundary, are controlled by interests identified with the American Metal Co. It is worthy of note that A. B. W. Hodges, who has been manager for several years, has just left New York to take charge of the Cerro de Pasco mines, in Peru, at a salary said to be $50,000 per year. Mr. Hodges, before leaving, declined to be interviewed regarding the Granby affair, saying, that as engineer for the company, his tongue was absolutely tied, and that he would not speak even in his own defence. Granby at $40 per share means only $6,000,000 for the mines. The company's surplus is nearly one-third of that, so that the stock-market seems to have more than discounted Mr. Sussmann's conservative report.

Other Coppers.—Pope Yeatman has cabled from Santiago de Chili that the ore reserves of the Braden Copper Co. are now seven million tons, averaging 2·94% copper. The management of the Cactus Copper Co., whose properties are near Globe, Arizona, report that all of the workings from the Hamilton shaft are in a disseminated copper ore averaging better than 2½%. A 2 ft. vein of solid malachite has been found running through 'disseminated' ore. The Cactus is a new mine recently opened under the auspices of the Calumet & Hecla party. Its reserves of commercial ore are already figured at above 2½ million tons.

California Oil stocks are beginning to invade the New York market. The fact that companies operating in the California oil-fields have been paying large dividends during the past few years, bids fair to fire the public imagination and precipitate a boom in oil shares such as that which has lately descended upon London. American investors seem to be without interest in late offerings of rubber plantation shares, however. They have evidently not forgotten the losses made in rubber descriptions ten or twelve years ago.

Gossip.—John Hays Hammond has turned his many-sided genius into the industrial field. He is backing Daniel J. Sully, once known as the king of the cotton market, in the exploitation of a new cotton gin. Sully's scheme is a broad one and involves the erection of warehouses throughout the South, in which the planters may store their cotton, taking warehouse receipts, which they can sell, or upon which they can borrow money.

C. W. Geddes, an engineer formerly connected with the Goldfield Consolidated, is reported as saying that the surface indications existing in the new Porcupine district in Northern Ontario are the most promising showings of gold ores he has ever seen.

VANCOUVER.

The Granby Consolidated will experience a change in the local management about the middle of March, when A. B. W. Hodges will leave Grand Forks for Lima, Peru, to become general manager for the Cerro de Pasco Mining Co. Mr. Hodges took hold of the Granby property in 1899, built the 4500-ton smelter, and placed the mines at Phœnix upon the present economical working basis. The property has paid over $3,778,630 in dividends since Mr. Hodges took charge. It is not understood that any radical change of policy will be made. This company made an important deal early in the month, whereby the Summit group of 1000 acres at Phœnix was acquired.

The Zinc Situation in the Kootenays may improve in the not distant future now that the Canadian Government is considering an appropriation of $50,000 to be spent in experimental zinc smelting. This is a subject of profound interest to the entire Slocan-Kootenay region, where zinc-lead ore abounds, as at the present time there is no plant in British Columbia or in Canada for the commercial treatment of zinc ore. The shipment of such ore to the United States smelters under the existing tariff entails a serious loss of income. With the money that has already been spent by local mining men and by the Provincial government, the appropriation of the Dominion government should place this matter in a more favourable light and lead to the establishment in this country of a suitable reduction works.

The Railways in this Province are vying with each other in a race for points of vantage. With the construction and operation of most of the new lines planned the mineral production should show marked progress, for in every instance new and rich mining districts will be opened up and facilities afforded to mining. The Great Northern has let contracts for most of its line from Princeton to Vancouver, with the exception of a rocky piece of road in the Hope mountains. The Canadian Pacific has declared its intention of rushing its line from Midway to Penticton and from that point over Hope mountains to Vancouver. This will give the rich Boundary, Similkameen, and Nicola mining districts direct connection with Coast points. The Canadian Pacific line from Elko to Golden will open up the Windermere mining country. The Grand Trunk Pacific is rapidly pushing its railway from Prince Rupert, on the Coast, up the Skeena River, piercing the Telkwa, Hazelton, and Babine mining divisions, where many rich copper and lead mines are being developed.

MAIKOP OIL-FIELD

By A. BEEBY THOMPSON

FOR many years the petroliferous character of what is now generally known as the Maikop district has been recognised and has been from time to time even the subject of investigation by geologists and oil prospectors, but the comparative inaccessibility of the region and the difficulties of collecting information in a country clothed in dense forests have delayed recognition of an important industrial fact. At points along the same belt —at Ilsky and Kudako, Anapa, in the Taman peninsula, and across the straits into the Crimea near Kertch—much money has been expended in profitless drilling by companies of high standing furnished with abundant resources. These failures have doubtless deterred operators from entering this new field.

The accompanying map shows the position of the Maikop oil-belt as at present imperfectly defined, and also indicates the extension of districts where oil-bearing strata are known to exist under varying conditions of structure and inclination. A photograph of the oil gusher when on fire, last August, is given on another page.

Unlike so many oil-fields of the world that of Maikop is situated within a lovely wooded region on the northern flanks of the western spurs of the Caucasus. A rich agricultural area with a large rural population lies to the north, and the climate is not subject to those extremes of temperature that characterize so many oil regions. The climatic conditions in fact resemble in many ways those of the Carpathian oil-fields. Rivers afford perennial supplies of fresh water, and when the district is opened up the malarial fever which is said to prevail in the summer, will doubtless diminish.

The oil-field has been closely investigated during the last few years by several Russian engineers but to V. Winda* is due the chief honour, as it is largely on acccount of his investigations and publications that world-wide

* 'The Maikop Oil Beds in relation to the Oil Industry of the Kuban Territory,' by V. Winda.

interest has been stimulated. While it is not difficult to determine the approximate structure of the field, direct evidence is not forthcoming over wide areas on account of the dense timber-growth and surface-soils. Speaking broadly, the beds of Oligocene age in which the oil occurs take the form of a regular monocline lying unconformably upon Eocene strata, which latter, so far as known, are not productive of oil. The direction of the Eocene and Oligocene beds does not appear as a defined line traversing the field in the line of strike but takes a sinuous route, which makes a local knowledge necessary to locate productive areas near the boundary line. The Oligocene beds have a northerly dip through the entire belt, but the inclination gradually increases from 5° to 8° in the eastern part of the field to 45° to 55° and even more in the extreme western portion. The width of exposed Oligocene strata consequently diminishes from 1½ versts (a 'verst' is about ⅝ mile) eastward to less than ½ verst westward.

The strata have a general northwest strike, but, as already stated, the southern limits of the Oligocene are decidedly irregular, while northward they are covered by more recent beds, classified as Miocene. Less direct information is obtainable toward the north, where the hilly ground of the principal portion of the oil-bearing area gives way to flat alluvial deposits, created no doubt by the rivers that traverse the area. A diminishing dip, however, has been observed in a northerly direction; consequently, the beds may be assumed to form a synclinal basin the limits of which are as yet undetermined. It is possible that a secondary flexure may bring the oil-beds again near the surface, but no evidence has been collected indicating this structure.

The Oligocene strata consist essentially of beds of clay or clay-shale associated with remarkable deposits of fish remains, such as teeth, scales, etc., and occasional layers of sand, much of which is decidedly petroliferous in character and in some cases charged with oil. The clays themselves are often petroliferous but are scarcely likely to prove sources of production. Some of the outcropping sand displays a considerable degree of impregnation with petroleum and emits a pleasant sweet odour when freshly disturbed, and in some regions it attains considerable thickness. To indicate the exceedingly rich nature of the outcrops, it may be stated that faces of bluffs representing some 150 ft. of oil-bearing strata can in some localities be seen covered with a layer of soft asphalt, the result of the oxidization of the exuding petroleum; this, on being removed, reveals the extent to which the beds are charged.

The oil-sand does not appear as a regular deposit over large areas but displays much lateral variation and probably exists in lenticular deposits. In the Shirvansky district it attains the greatest visible thickness in outcrops, but toward the west the clay thickens at the expense of the sand, which shows a marked diminution. Toward the extreme east also it is said that the beds of sand decrease in importance, but the diminishing dip in this direction and greater concealment of the Oligocene beds by alluvial deposits reduces the amount of available evidence. As at present defined, the choice of the field must be considered to lie in the district between the villages of Neftiania and Shirvansky.

The thickness of strata through which petroliferous indications are displayed is at least 1400 ft. and most of the beds of sand of a suitable character will probably prove productive of oil within that horizon, although it is not impossible that some may prove water-bearing.

While the southern limits of the oil-field are defined by the Eocene beds, the northern limits are the subject of much local speculation. A constant dip equal to that at the outcrop would confine the workable width of the belt to from 3½ miles in the eastern part to 1 mile on the western fringe, but evidence favours the synclinal structure, which brings a reduction of the angle of dip on receding from the outcrop in a northern direction. Even allowing for this structure, the line along which the petroliferous horizon is reached at 2000 ft. would not greatly exceed these figures.

There are other important matters that have to be considered in relation to the northern lands, when considering their possible merits as oil-producers. The considerable lateral variation along the line of strike may be equally prevalent in the direction of dip, consequently the oil-sand so perfectly exposed between Neftianaia and Shirvansky may diminish in thickness toward the north or even disappear. On the other hand, other parts of the field exhibiting a paucity of sand may prove richer in a northerly direction. It is also impossible to state how far down the slopes of the basin drilling can be continued without penetrating water that may have saturated the sand. Trial drilling alone will prove these facts. The northern tracts must naturally be the object of much speculation until drilling has definitely decided the question.

At many points along the Maikop belt of

exposed Oligocene beds there are evidences of oil. In the eastern field numerous native pits sunk in the outcropping sand have for years yielded small supplies of oil, which found a ready local sale. Westward, where the beds are more steeply inclined, extensive deposits established by a succession of highly productive wells. One well alone, at a depth of less than 300 ft., amid the outcrops and near the Eocene beds, has yielded an estimated production of 6000 tons daily, and many others are said to have flowed a little.

OIL GUSHER AT MAIKOP ON FIRE, AUGUST 1909.

of asphalt bear testimony to the petroliferous character of the strata, and at one locality ozokerite, a natural paraffin wax, occurs in fissures. The highly productive character of the district has now, however, been conclusively

A total estimated output of over 50,000 tons of oil from a single well at such a shallow depth amid the outcrops, and near the boundary of the Oligocene and Eocene, naturally calls for some special explanation. Under normal circumstances we would not expect such results at such a position. An explanation is probably to be found in the fact that the most elevated point of the lower Oligocene beds in which non-outcropping oil-sands occur comes into direct contact with the Eocene strata, which have acted as a barrier against which the oil and gas have been arrested in their ascending movement and so accumulated.

Although the strata composing the Oligocene series present the necessary conditions for the storage of petroleum, the structure is unusual. Most oil-fields, where exceptionally productive wells have been struck, are situated on well defined anticlines, along the axes of which the gas and oil have accumulated; but in this case a production rarely excelled anywhere has been obtained on a regular monocline where the inclination of the beds is gentle. The structural features resemble the great Coalinga oil-field of California, where the productive beds lie at a gentle inclination and outcrop on the hills. In this field, however, no important productions have been struck near the outcrops, while several miles away, where the unfavourable influence of the outcrops would not extend, large productions have resulted. Consequently it is quite possible that the deeper sources, which dc not outcrop at the surface but whose edges come in contact with the Eocene beds, will prove the greatest producers; while the upper ones, which appear on the surface, will only yield on a large scale scale at points removed from the immediate neighbourhood of the outcrops.

Reviewing the whole circumstances, including the results achieved already, it is difficult to exaggerate the importance of the Maikop district. Its geographical position gives it facilities that can be claimed by no other European oil-field, and few foreign fields, for it is within 50 miles of a European port. A railway is under construction from the Black Sea port of Touapse to Armavir, a station on the main Russian system, and will cross the western end of the oil-field. Already several projected pipe-line schemes are under consideration by capitalists.

The prospects for operating cheaply are excellent, as the geological conditions are exceedingly favourable. The strata, with the exception perhaps of one or two localities, are not much broken or disturbed and their inclination in the eastern part of the field is insignificant. The early wells are likely to be sunk within shallow territory and it is possible that in some localities it will be possible to drill and equip wells ready for production within a few weeks, when suitable drilling appliances become available. Likewise the cost of production is likely to prove unusually low, as there will be an abundance of gas available for power purposes, and the productive wells have so far exhibited no signs of the water or sand that makes most Russian wells so costly.

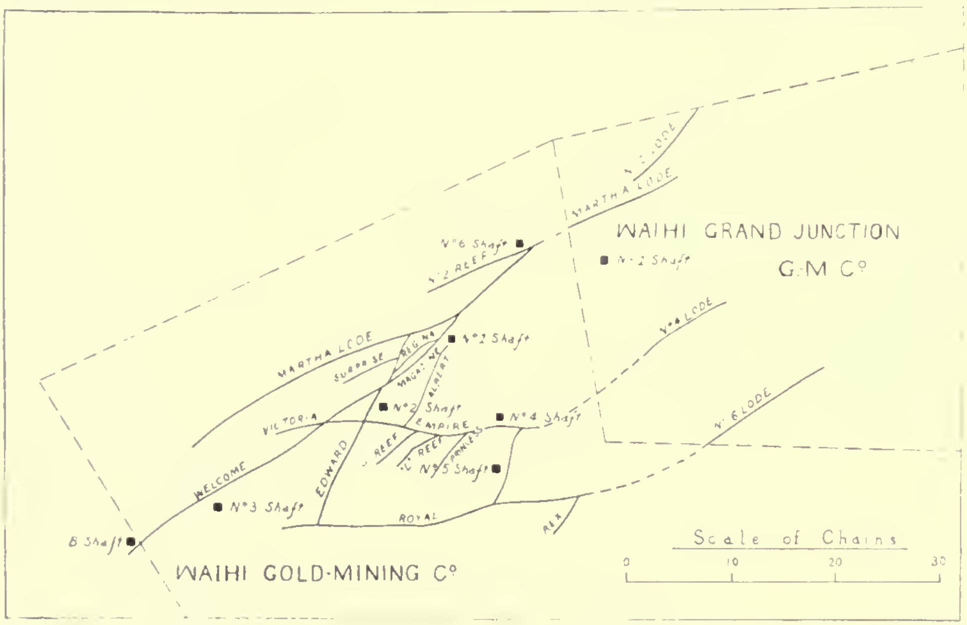
Without pretending to compare Maikop with Baku, where the geological conditions are quite different, it is interesting to recall that in the early developments of the Caucasian district great flowing wells were struck at depths of a few hundred feet. At that time drilling was not the science into which it has since developed, and, although great difficulties were found in carrying wells even to those shallow depths, the price of oil at the wells fell as low as a shilling per ton and until 1898 never reached 12 shillings per ton. The expenditure of about £1,000,000 at Maikop, as seems reasonably probable during the next year or two, cannot fail to produce results that will temporarily demoralize oil-markets and reduce prices to an unprofitable figure except on the most favoured tracts. The geographical position of the field, however, is such that almost unlimited facilities for export can be quickly established and once in communication with the sea it is only a question of time to open up markets for the remunerative disposal of the product. The early development of the Californian oil-fields in 1905 led to the price of oil falling to 3 shillings per ton, but although production increased annually the price quickly mounted to £1 per ton, at which it has remained fairly stationary since, and yields a handsome profit to producers.

Mineral Output of Canada.—The preliminary report of the statistical department of the Canadian Government relating to the output of metals and minerals in Canada during 1909 was published in March. The total output of metals was valued at $45,188,387, and that of coal and other non-metallic minerals at $30,587,591; these figures compare with $41,774,362 and $32,142,784 during 1908. The output of gold was worth $9,790,000 and of silver $14,358,310, as compared with $9,842,105 and $11,686,239. The production of copper shows a decrease, being 54,061,000 lb. valued at $7,018,213, as compared with 63,702,873 lb. valued at $8,413,876. Other figures were 45,857,424 lb. of lead and 26,282,991 lb. of nickel in matte, both of which showed an increase. The production of coal was 10,411,955 tons, practically the same as in the previous year, and of asbestos 63,349 tons.

THE ORE DEPOSITS OF WAIHI, NEW ZEALAND

By A. M. FINLAYSON

Introductory.—Waihi, the premier gold-mine of Australasia, is situated at the south end of the Hauraki goldfield, 70 miles by rail from Auckland, in New Zealand. The Hauraki district is of the well-known Tertiary type, the veins being contained in andesites and similar volcanic rocks of Miocene age. Two vein types are recognizable—a northern and a southern. The veins of the northern type, in the Thames and Coromandel districts, are characterized by irregular bonanzas, often astonishingly rich, such, for instance, as the famous 'patch' in the Caledonia vein, on the Thames, which yielded 9 tons of gold in 15 months. The veins have failed to yield profitable ore below about 1000 ft., and for the most part have not been remunerative below 600 ft. In the southern portion of the district, where Waihi and Karangahake are the chief mining centres, the veins are larger and stronger, the vertical range of profitable ore is greater, and bonanzas are practically absent. The pay-ore occurs in uniform and extensive shoots.



The early history of the Waihi mine was devoid of sensation. The outcrop of the main lode on Martha hill was discovered in 1878, and the first prospectors encountered much opposition from the Maories, who resented this intrusion into their territory. The early reports, in spite of an assay of over one ounce of gold per ton from an outcrop-sample, were not regarded with much favour. In 1881, the Martha Gold Mining Co. was formed to work the property, and up to 1889, crushed 18,000 tons of ore, for an average return, by copper-plate amalgamation, of only 13s. 6d. per ton. Early in 1889, the present owner, the Waihi Gold-Mining Co., acquired the mine, and fresh impetus to its development was given by the introduction of the cyanide method in 1894. Since that date the record of the mine has been one of increasing output and large dividends, while it has won a leading place in metallurgical practice. The capital of the company is £500,000 in £1 shares, and up to the end of 1908, there had been treated 2,827,137 short tons, for a return of £7,220,624 worth of bullion. Dividends have amounted to £3,325,386. 7s. 8d., or 46% of the value of the output. During 1908 the amount of ore treated was 393,214 tons, for a return of £2. 14s. 10d., being at the rate of 10 dwt. 21 gr. gold, and 4 oz. 11 dwt. 21 gr. silver. The average value of the bullion was 11s. 3d. per oz., and the estimated cost of treatment, including all expenses both in New Zealand and London was 19s. 4·8d. per ton of ore. The extraction was 90% of the gold and 75% of the silver. The dividends for 1908 amounted to £454,058. 11s., or 17s. per share, and the reserves were estimated at 1,329,872 tons. Adjoining the Waihi company's lease to the east, and operating on the same group of veins, is the property of the Waihi Grand Junction Company.

Geology of the District.—The country-rock consists of a thick series of lavas and tuffs, chiefly andesite and dacite, with possibly some more acid types. Adjoining the veins, these rocks have been intensely altered by hydro-thermal action, with the formation of a pyrite-sericite-carbonate rock*, the so-called 'propylite.' Overlying these, and separated by an old land-surface, is a younger series of andesites, into which the veins do not extend. Both these formations are covered, for the most part by extensive flows of younger (Pliocene) rhyolite, occupying all the lower parts of the district. Martha hill, 630 ft. above sea level, is an isolated inlier of the older auriferous rocks, surrounded by the younger barren formations. By its altitude it has apparently been saved from submergence under the thick series of later lavas that have covered all the lower ground, and thus has protected the 'mother lode,' which crops out conspicuously on the summit of the hill.

The Vein-System.—The main lode of the Waihi system is the Martha, whose outcrop of chalcedonic quartz and sinter has been removed in a large open-cut. It strikes north-northeast, dipping southeast at an average angle of 75°. On the surface, the vein disappears down the flanks of the hill, under the cloak of younger barren rocks, but underground it has been proved for nearly a mile in length, and is the mainstay of both mines. The width of ore at surface varied from 5 to 50 ft. On the 150 ft. level, where it is joined by several other veins on the hanging wall, the lode attains a maximum width of 120 ft., its average being 30 to 50 ft. On the 1000 ft. level, where the lode has lately been intersected, the lode is 80 ft. wide.

Three veins, the Welcome, Regina, and Magazine, constitute hanging-wall 'leaders' to the Martha. They run approximately parallel to it, on its south side, and stand nearly vertical. They not only join the Martha on the dip, but run into it and into each other eastward. The Welcome lode outcrops with a width of 20 ft., and is traceable for 2000 ft.: it joins the Martha on a south-westerly pitch between the 280-ft. level and 850 ft. At this lower level its width is 70 ft. The Regina is a smaller vein, which coalesces in part with the Welcome and in part with the Martha; it does not reach the surface, but pinches out, in rising, at 136 ft. beneath the surface. The Magazine is a similar lode, averaging 8 ft. in width, and likewise pinching out before reaching the surface. The combination of these three veins with the Martha in depth results in the greatly increased thickness of that lode at and below the 700-ft. level.

The Edward lode, one of the strongest and most valuable of the group, strikes about north and south, connecting the Welcome and Royal lodes. It peters out 400 ft. below the surface, but becomes gradually stronger in depth, its mean width on the 850-ft. level being 75 ft. The Empire lode, another important member, runs approximately east and west, joining up with the Welcome and Edward to the west. Its width on the 136-ft. level is about 6 ft., and it dies out immediately above this. In depth it becomes wider, reaching 25 ft. on the 850-ft. level, and over 30 ft. on the 1000-ft. level. This vein is believed to extend for a considerable distance east into the Grand Junction lease. The Empire is attended by several spurs, both on its hanging wall and footwall. Of these, one of the chief is the Albert, which goes up to the north toward the Martha. The Royal lode lies south of and parallel to the Empire, and dips steeply north. It reaches up to the old land-surface of the gold-bearing dacite, and is there cut off by the overlying rhyolite. At a depth of 280 ft it has a width of 10 ft., and at 1000 ft. it is 16 to 35 ft. The following figures, showing the quantities of ore mined from the different lodes in the Waihi mine during 1908, give an approximate idea of their relative importance at the present time:

Vein.	Tons.
Martha	224,444
Welcome	46,570
Empire	45,802
Royal	45,727
Edward	40,159
No. 2. Reef	10,432
Albert	7,597
1 Reef	2,951
Victoria	1,157
Princess	891
Regina	346
Rex	155
	426,231

* A. M. Finlayson, *Economic Geology*, Vol. IV., p. 633.


MAP OF NEW ZEALAND
Showing Goldfields and Deposits of Coal, Petroleum, Iron, and Tungsten.
G = Gold Gravel.
Scale of Miles
0 50 100 150 200
Coal
KAMO
AUCKLAND
COROMANDEL
THAMES
Hauraki Goldfield
WAIHI
Coal
TAUPIRI
Petroleum
GISBORNE
Coal
MOKAU
Auriferous Sand
NEW PLYMOUTH
Petroleum
NAPIER
WELLINGTON
COLLINGWOOD
Iron
NELSON
SEDDONVILLE
Coal
Reefton Goldfield
WESTPORT
REEFTON
Auriferous Sand
G
Petroleum
GREYMOUTH
Coal
CHRISTCHURCH
CROMWELL
Tungsten
Otago Goldfield
G
Coal
Tungsten
SHAG PT
ROXBURGH
WAIKAIA
WAIKAKA
C
Coal
NIGHT-CAPS
Coal
DUNEDIN
Oilshale
DREPUKI
KAITANGATA
CLUTHA RIVER
INVERCARGILL
170° 172° 174° 176° 178°
168° 170° 172° 174° 176°
36° 38° 40° 42° 44° 46°

The chief lodes worked in the Grand Junction are the eastern extension of the Martha, with an additional vein, the No. 2, northeast of it, the No. 4, and the No. 6 vein. These two last, south of the Martha, are believed to be extensions of the Empire and Royal lodes, respectively.

An important feature of the lodes, it will be observed, is the fact that many of them fail to reach the surface of their enclosing rock, while on the other hand their width generally increases downward. The vein-system is apparently an isolated one, and the formation of the fissures has not been accompanied by much faulting. They are probably due to a local system of stresses, operating comparatively near the surface, over a centre of thermal or igneous activity.

The Ores.—The lode-matter is essentially fine-grained grey quartz, with a little calcite. It is impregnated with grains and strings of pyrite, argentite, and blende, and with occasional galena, as well as other sulphides. Analyses reveal the presence of cobalt and selenium, the last element being present in the bullion, from which it is extracted during the refining process. The gold occurs partly free, in an extremely fine state of division, and partly combined with the pyrite, and the proportion of gold to silver in the ore is about 1 to 7. The lode-walls are fairly defined, but are seldom marked by clay selvages, while there is frequently a gradual transition from payable ore to barren country rock. Microscopic examination in such cases shows a progressive silicification of the dacite, till the lode-matter is reached, containing chlorite and sometimes secondary orthoclase (valencianite).*

There is in addition, a type of lode-material composed of white and more coarsely crystalline quartz. It carries pyrite, but seldom any other sulphide. This ore is typical of the poorer portion of the veins, and the difference between the two types of ore is to some extent due to replacement in the one case, and to the filling of opened portions of the fissure in the other case. Calcite is common in the deeper workings, accompanying the poor crystalline quartz, and in this connexion it is noteworthy that in the neighbouring Waitekauri district, the appearance of calcite in the lodes generally indicated low-grade ore.†

Ore-Shoots.—In comparison with the bonanza district of the Thames and Coromandel, and with most of the Tertiary goldfields of North America, the distribution of pay-ore in the Waihi lodes is remarkably uniform. Ore-shoots as a rule are concentrated along either or both walls of a lode, more especially in the wider lodes, where the central portion, being low grade, is sometimes left as a pillar during stoping. The best-known shoot in the mine is that of the Martha lode, which maintains a length of over 1000 ft. from the 136-ft. to the 850-ft. level, and continues to the 1000-ft. level. The pay-ore throughout this shoot has been remarkably uniform in value, averaging £2. 14s. per ton, while the ore on the 1000-ft. level assays £3 per ton, the ore stoped being 50 ft. out of a total width of 80 ft. This shoot pitches at a steep angle to the northeast, and if it persists it should eventually be reached in the Grand Junction mine, in which the Martha lode has hitherto been low-grade. A marked enrichment was observed on the Martha where it was joined by the Welcome and other lodes on its hanging wall, and the shoot here followed the plane of junction of the lodes. Above the junction with the Martha, the Magazine vein is low-grade (5 to 6 dwt. per ton), while the Regina is richer. A good orebody occurs on the Welcome vein, the length of pay-ore on this lode being greater as the lode approaches the surface. The richest ore in the Edward lode is at its junction with the Martha. Here, on the 850-ft. level, it is 75 ft. wide, and gives an average assay of £10. 10s. per ton. Exploratory work on this lode to a depth of 900 ft. shows assays of from £5 to £16 per ton. The Royal carries an ore-shoot which increases in length from 300 to 1400 ft. between the 280 and 850-ft. levels. The oreshoot of the Empire lode shows a similar extension in depth.

In general the occurrence of ore-shoots at Waihi seems to have been determined chiefly by the numerous lines of fissure-junction, the shoots generally showing a pitch that corresponds to the inclination of the plane of junction of any two veins. Variations in the nature of the enclosing rocks do not appear to have influenced ore-deposition; the country rock, indeed, is remarkably similar throughout, partly in consequence of the intense alteration of the rocks—both lava and tuff—to a similar mineral aggregate. Ore deposition has been, however, influenced by replacement, while the ore deposited in open portions of the fissures is, as already remarked, generally poor. It is a noteable fact that the larger and stronger lodes are generally the richer. The country-rock separating different lodes is traversed by numerous

* W. Lindgren, *Eng. & Min. Journal*, 79, 1905, p. 220; A. M. Finlayson, *Economic Geology*, Vol. IV., No. 7, p. 638.

† P. G. Morgan, *Eng. & Min. Journal*, May 4, 1905.

thin quartz veins which seldom contain pay-ore. The wider lodes, moreover, are those in which replacement has been dominant, this process being largely responsible for their increasing width in depth.

The Oxidized Ore.—The outcrop of the Martha lode is a finely crystalline silicious sinter, iron-stained and sometimes banded. It is similar in character to the sinter deposits formed at the present day by the hot springs in the thermal district of Rotorua. A sample of the ore taken in 1878 by the first prospectors gave a return of 4 oz. 6 dwt. bullion per ton. The distribution of the oxidized ore in the Martha has been a much discussed feature. The lode is oxidized on the hanging wall to a depth of 555 ft., although traces of oxidation are seen at a depth of 850 feet. The sulphide ore appears first on the foot-wall at 136 ft., and gradually increases till at 555 ft. it occupies the whole width of the lode. In the oxidized ore, which carries over 90% silica, the calcite has been pseudomorphed by secondary quartz, giving a cavernous or platey structure. The oxidized zone has generally been profitable and sometimes rich, one recorded assay giving a return of 2 oz. 5 dwt. 17 gr. gold, and 10 oz. 2 dwt. 12 grs. silver per ton.

The proportion of gold to silver in the oxidized zone is about 1 : 3 or 1 : 4, as against 1 : 7 in the unaltered ore. There has thus been a removal of silver during the oxidation. In passing down into the sulphide ore, the contents show either no change, or else an improvement. Thus the sulphide ore first found assayed at the rate of 1 to 2 oz. gold, and 30 to 60 oz. silver per ton, while some rich ore yielded 25 oz. and 1000 oz., respectively.* These facts shew a concentration of silver and a certain amount of sulphide-enrichment immediately beneath the zone of oxidation. There is, however, no definite zone of enriched sulphides succeeded by primary lean sulphides. Further, the sintery outcrop of the Martha lode and the fact that many of the lodes do not reach the upper surface of the enclosing rocks, indicate, as pointed out by J. M. Bell and C. Fraser,† that there has been little denudation or accompanying enrichment. The Martha Hill is 630 ft. above sea-level, and the depth of the zone of oxidation approximates to the present level of ground-water. The process of oxidation is evidently of a purely superficial character.

Rich Sulphide Ore.—The deeper parts of several of the lodes carry a finely-banded sulphide ore of high value. The bands are composed of fine sulphide, chiefly pyrite and argentite with finely divided free gold, alternating with thin seams of white quartz. A drusy structure is common, and the quartz shows crustification. This ore occurs locally in the ordinary lode-material and is generally accompanied by brecciated ore. Microscopic examination shows the thin bands of quartz and sulphides penetrating the replacement-ore along minute fissures, and the banded ore is evidently of later date. It appears to have resulted from fracturing and movement along the lode-zones, which gave access to deep-seated alkaline waters carrying gold and sulphides in solution. In other words, there has here been an enrichment of deep-seated origin, following on the first stage of lode-formation. This phenomenon has been discussed by Walter H. Weed,* and has been suggested by him as the cause of the rich copper mineral in the deep-level ore of Butte and Neihart. At Waihi, this enrichment, which shows all the features of a subsequent origin, has not reached the present surface, but extends chiefly from 700 ft. down to the lowest depths reached (1000 ft.) and shows every indication of extending deeper. The banded sulphide ore is responsible for the high values in some of the lodes on the lower levels, such as the Edward lode, which at a depth of 850 ft. assays £10 per ton for over 200 ft. along the level, and is still maintaining its value underfoot. Similarly the Royal, carrying banded ore, assays £8 per ton over a width of 20 ft. on the 1000-ft. level of the Grand Junction mine. The Empire lode is generally low-grade in depth, but rich banded ore has lately been found between the 8th and 9th levels, assaying nearly £6 per ton, and in the Grand Junction mine, a lode, which is believed to be the Empire, carries, at a depth of 1000 ft. a foot-wall seam of banded sulphides 17 ft. thick, assaying £3 per ton. Some lodes, on the other hand, do not appear to carry this ore. The Albert, for example, becomes poor below 600 ft., although it yielded good ore above.

The banded sulphide ore is, in short, the chief factor in the economic development of Waihi, and, as has been pointed out by others, the prospects of the lodes in depth are good. Thus the neighbouring Talisman mine is working on this class of ore at a depth of 2000 ft. below the outcrop of the Talisman lode, and the Grand Junction mine appears to be finding continual improvement in depth, its ores on the upper levels being somewhat low-grade.

* P. G. Morgan, *Eng. and Min. Journal*, May 4, 1905.
† *Canadian Mining Journal*, Sept. 1, 1908.

* *Trans.* Amer. Inst. Min. Eng., Vol. XXXIII, 1902, p. 747

At the same time the existence of the deep sulphide ore should not be taken too literally as indicating any unusual depth of pay-ore. Some optimists have compared Waihi, as regards its prospects in depth, to the saddle-reefs of Bendigo, Victoria. This is quite unjustified, as Bendigo and Waihi have no geological feature in common. It is becoming better recognized that types of ore deposits genetically similar have also a similar range of persistence, and the experience of the Tertiary goldfields the world over goes to show that the vertical range of pay-ore is restricted. The ore has been deposited comparatively near the surface and the lodes cease to be profitable at depths ranging from 900 ft. or even less, down to 1800 ft. While, then, the improved widths and values of some of the Waihi lodes in depth are favourable features, it cannot be considered likely that the vertical range of pay-ore will be markedly greater than that on other goldfields of the same type.

Treating Zinc Ore.—We have already mentioned in previous issues that low-grade zinc ores are receiving renewed attention from metallurgists. One of the recent processes is that described in British patent No. 26,711 of 1908, granted to J. R. Williams, H. W. Bradley, and B. Bradley. As this process is being tried on the zinc-lead ore found at Broken Hill, Rhodesia, a short account will be of interest. The object of the invention is to dissolve zinc from the ore by means of sulphuric acid under such conditions that no other metal is dissolved and the silicates in the ore are not attacked. As a rule the action of sulphuric acid on silicates is to make a gelatinous mass that soon puts an end to percolation. The inventors use a dilute solution of zinc sulphate carrying a small proportion of free sulphuric acid. This solution circulates through the ore and then passes to an electrolytic cell in which a determined amount of zinc is precipitated on the cathode. The solution is by the same electrolytic reaction regenerated so as to contain the original proportions of sulphate and free sulphuric acid, and it is then sent back to the ore once more. By this continuous process no sulphuric acid is lost.

Titanium gives promise of extended use in steel and cast-iron. In steel it is ordinarily introduced as ferro-titanium, with from 10 to 20% tatanium, sufficient to make up approximately 0·1% of the steel. Rails treated thus show great resistance to wear. Gray cast-iron is also made harder by such treatment.

Dredging in the Yukon.

Before 'leaving for the outside,' as the annual migration at the end of the summer season is termed in the North, Joseph W. Boyle gave some interesting particulars for publication in the *Dawson News*, of November 26, 1909. Mr. Boyle is manager for the Canadian Klondike Mining Co., which operates a dredge on Bear Creek, a tributary of the Klondike.

Three points are emphasized by Mr. Boyle in his statement: (1) The actual cost of operating the dredge and power-plant, including maintenance and repairs, labour and fuel, has this year been less than 15 cents per cubic yard of material handled. (2) The proportion of lost time during the season is less than that of a number of similar boats operated in California. (3) The length of season is greater than was formerly supposed to be possible. Mr. Boyle expects to be able to run the dredge 224 days next season. In his comparisons of operations made by dredges in California, Mr. Boyle quotes D'Arcy Weatherbe, writing in the *Mining and Scientific Press*, and he adds that it is due largely to such data being given to the public that the dredging industry has reached its present state of efficiency.

The Bear Creek dredge started digging this year, on May 9, and stopped on November 20, a total of 194 days and 8 hours. During that period the boat dredged 681,616 cu. yd. or an average of 3558 cu. yd. per day throughout the season. The total lost time was 368 hours 43 minutes, or 7·9% of the total running time.

This dredge has buckets of $7\frac{1}{2}$ cu. ft. capacity and is electrically driven. It has several appliances not installed on any of the other dredges operating in the Yukon, the principal being a steam-heating plant with pipes extending the entire length of the enclosed stacker-ladder, arranged on either side of the stacker-belt in such a manner as entirely to prevent any freezing of the belt. Steam-coils are placed under the lower belt-rollers, under the sluicing-tables in the enclosed house constructed over the main drive, and at all other points necessary to be kept free from frost. On different occasions during November the dredge was operating when the temperature outdoors was 20° below zero, without the slightest difficulty, and with all the efficiency that it would have in warm weather. A system of applying hot water to the sheaves, through which the various shore-lines operate, also serves to prevent any difficulty from the excessive cold. These improvements should prove useful, and stimulate the application of dredging in the North.

GRAPHIC METHODS FOR MINE-VALUATION

By HENRY C. JENKINS

THE problems to be faced in the course of a rational treatment of the subject of mine valuation do not lend themselves to mathematical analysis, for although certain general principles can easily be thus set forth, yet when definite numerical results for particular cases are required, the various factors will be found to be of so complex a character that even an approximate solution has been heretofore impracticable, except by methods that really are those of trial and error, the application of which has demanded a previous close experience of an almost identical case.

It is, therefore, not surprising that, in the absence of any sure guide, and notwithstanding the publication of papers dealing with certain limited phases of the economy of mine-work, a great deal of doubt and misconception, even among many of those in charge of operations, should exist, particularly as to the exact point to which stoping should be carried in a developed mine, so as to secure the maximum possible profit, as well as what that maximum profit may be, or whether indeed the conditions are such that a profit is definitely possible.

The following general treatment of the subject, by strictly graphic methods, has been developed in the course of my work, and does not seem to have previously been published; it gives a definite numerical answer on each of the above points, besides some curves, which, as elucidating the economic conditions under which the particular deposit may be worked, may be considered characteristic curves of the mine.

It must be premised for the purpose of such an investigation that the mine has been duly opened by shafts, winzes, cross-cuts, and levels, that the various items of cost in equipment, mine-work, and treatment can be stated, and that the mine has been systematically sampled. The sampling, moreover, must be thoroughly representative of what the stoping would be, and show the values of the ore as it would be stoped, or as it would be left, as well as the several tonnages of the different gradations in value; this is mainly important where a little rich ore exists in ground that subsequent calculation shows to be too poor to stope, or where some valueless ground is mixed with what proves to be valuable in such a way that it cannot be left behind.

In the case of a deposit of uniform thickness, opened by levels equidistant, and sampled at regular intervals, a sorting of the samples in the order of their respective assay-values would indicate the proportion in which these values occurred. It should also be premised that means exist at the mine for the identification of ore below any predetermined value, so that this shall not be stoped.

The costs that an ore has to bear can be readily separated into two groups: (1) Costs such as those for stoping, tramming, hoisting, and supervision, together with a certain part of the current repairs, in fact, all that are simply and directly dependent upon the tonnage of the ore won; and (2) Costs that are more or less constant in amount, necessary to the operations, but independent of the tonnage extracted, such as the following:

- (a) Costs of shafts, hoisting, pumping gear, and of levels and winzes.
- (b) Interest on these costs during the life of that particular part of the mine.
- (c) Cost of maintaining shafts and levels in working order until exhaustion has taken place.
- (d) Cost of pumping.
- (e) Office charges of development.

All these charges are of so definite a character that they may be considered to vary but little in the gross, whether the whole deposit exposed be stoped, or one half of it or more be left behind.

The cost reckoned upon each ton stoped must on this account vary greatly in the different cases, but may always be represented by one ordinate of the rectangular hyperbola AB (Fig. 1); one well-known property of this curve being that the product of its two co-ordinates is constant. By making therefore the terminal ordinate BX of this curve equal to the cost per ton, when all the lode bears the cost, and the length OX equal to unity, and then drawing intermediate points so that the product of the co-ordinates of each point is equal to that of BX by OX, the curve at each point will exhibit by its abscissa some fractional part of the deposit, and by its corresponding ordinate the cost that each ton of that part must bear in order to redeem the initial expenditure necessary to open the mine and provide for the development, pumping, and depreciation.

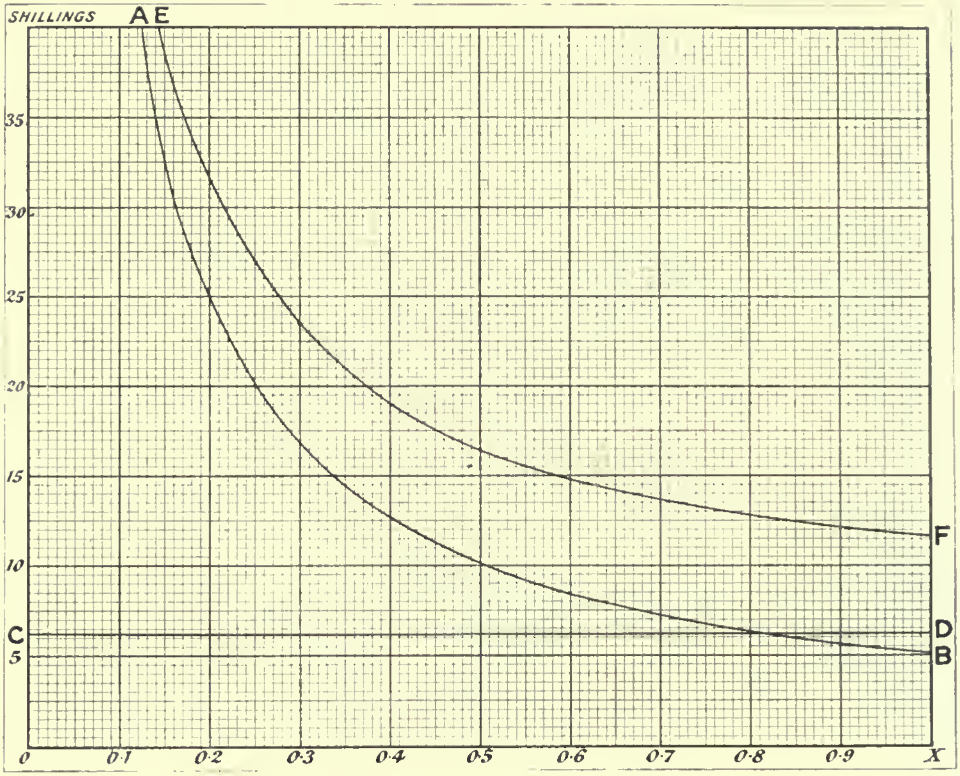


Fig 1. Curve of Cost.

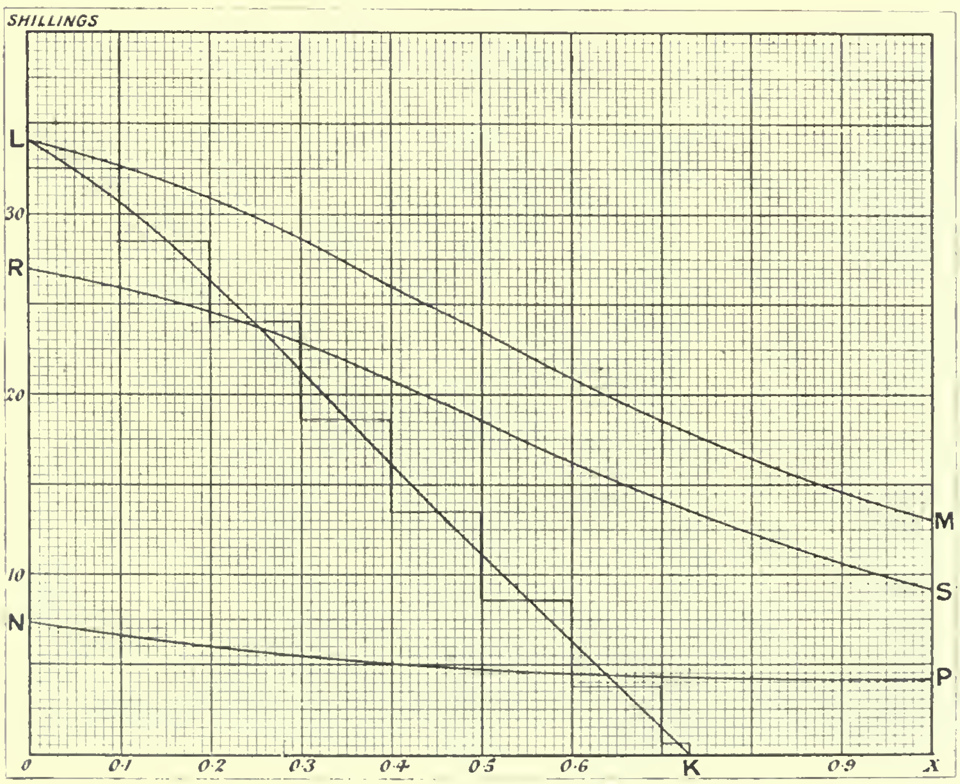


Fig 2. Curve of Value.

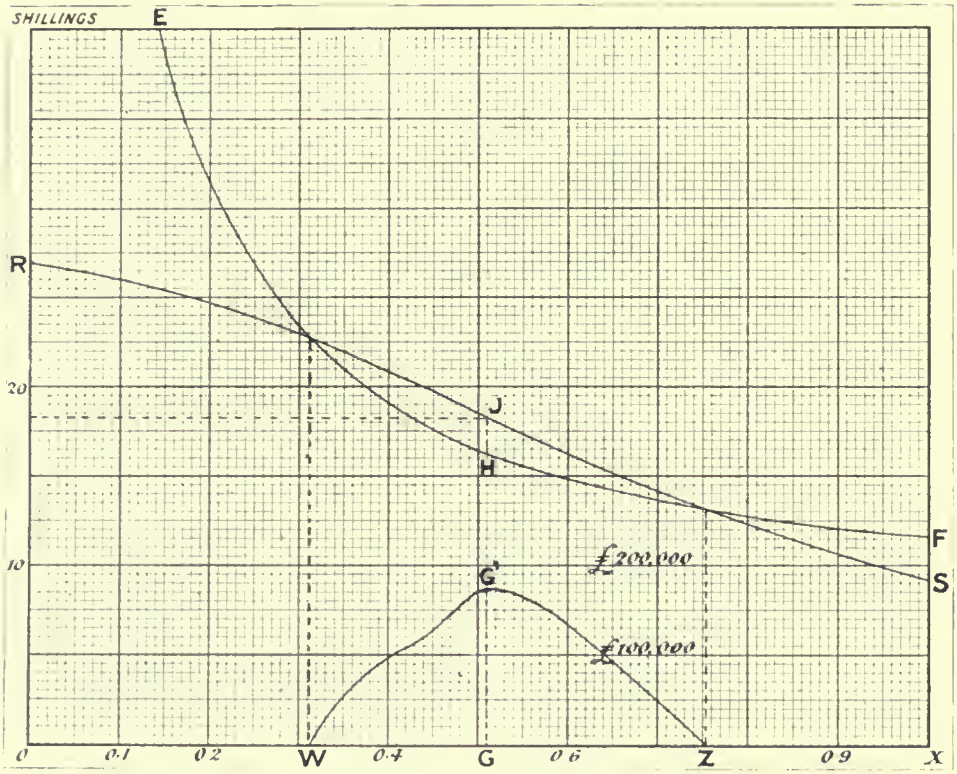


Fig 3. Curve of Profit.

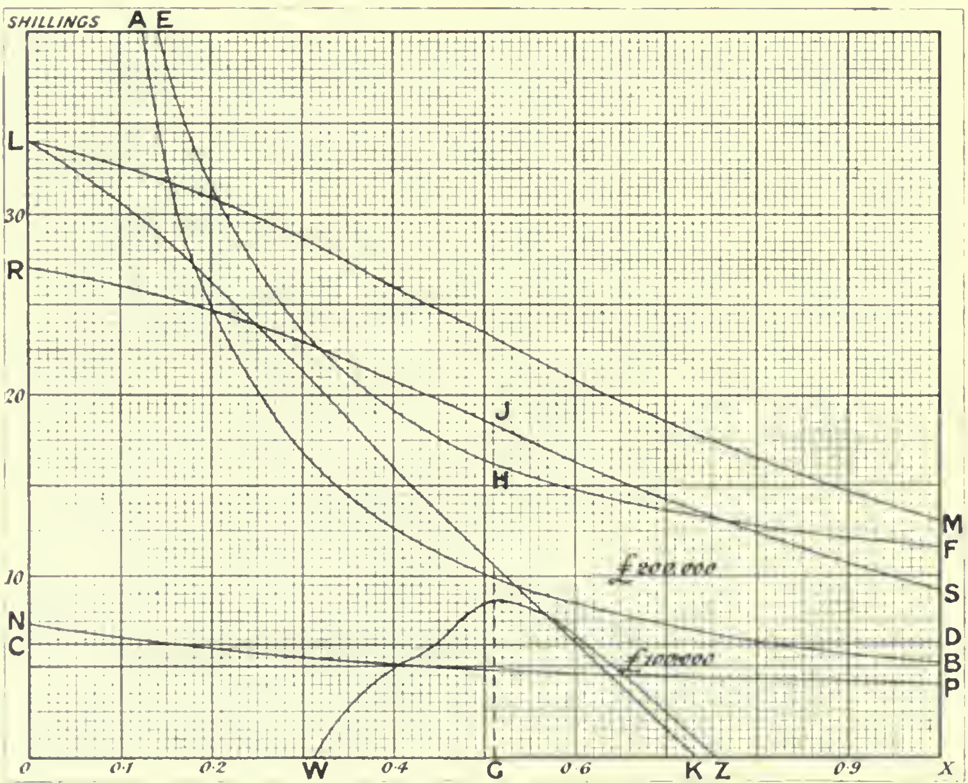


Fig 4. General Case.

In addition to the variable tonnage-charge indicated by the curve AB, there will be the constant tonnage-charge to consider; this can be represented by a line such as CD, drawn parallel to OX. If now a third curve EF be drawn such that every vertical ordinate in it is equal to the sum of the ordinates of AB and of CD at that spot, we have a graphic representation of the total tonnage-costs that must be charged to the ore according to the proportion that the ore stoped bears to the total deposit exposed.

In the example given in Fig. 1, the rectangular hyperbola AB has been drawn upon the assumption that the shaft, with a charge for interest covering a useful life of 15 years, and its depreciation, will have cost £50,000; that the cost of the levels will be £2000 per 10,000 tons of ore exposed; that 3,000,000 tons of ore, good and bad, have been so developed, and that if all this were stoped in 15 years the pumping and office charges would be £125,000. These conditions give us a charge of 5s. 2d. per ton as the value of the ordinate BX for the case where all the lode is stoped under the conditions just assumed. But any other conditions are just as easily expressed, and it may be noted that, by making a sufficient number of calculations for each point of the variable curve AB, we need not assume it to be a hyperbola at all, but introduce into it any departures from such a curve as practical considerations relating to the variables may suggest. The straight-line curve is supposed to represent a true tonnage-charge of 6s. 4d. made up of: stoping 5s., tramming 6d., hoisting 9d., and one penny for the repairs due to tonnage. All these are merely by way of example, and in any particular case the resultant curve EF will represent by its vertical ordinate the total cost per ton when the fraction of the total deposit stoped is only that represented by the abscissa to the same point, the whole length of the curve OX being taken as unity.

It is next required to show the value of the ore in a corresponding manner. Let the curve LKX (Fig. 2) represent the results of the sampling where the lode is considered to be made up of parts that can be sorted out according to their respective degrees of richness. We may have discovered, for example, that out of the 3,000,000 tons supposed to have been developed, one tenth, or the richest 300,000 tons, has an average value of 32s. 6d. per ton, and successive tenths show values of 28s. 6d., 24s. 0d., 18s. 7d., 13s. 6d., 8s. 7d., and 3s. 8d., respectively; while 3% of the total has a value of 6d. only, and 27% is barren.

These values can be plotted at once in a step-like curve, and the clean curve LK drawn through the steps. It is characteristic for the richness and distribution of the values in the ore, and may be called the 'assay-curve' of the mine.

In many cases an inspection of the results of the assays of samples will instantly give this series of values, for instance, when these have been taken uniformly apart and over uniform widths; while in the other cases the proportions are easy to deduce from the sampling-book and the assay-plan.

Before it is of much use for the general solution, the assay-curve must be integrated from left to right, that we may obtain the curve LM (Fig. 2), every vertical ordinate of which will represent the average value of the whole of that part of LK that lies to the left of it. This is easily done by the use of the squared paper upon which the curves should be plotted, and from which the area may be read by counting the number of squares enclosed by LK; this total divided by the value of the abscissa to the point gives the ordinate there for the new curve LM, which represents by its ordinates the average values of the ore when the richest parts of it are being stoped to that proportion of the total indicated by the abscissæ.

These values must in all cases be diminished by the cost of treatment before the net value for the market is obtained, and for this purpose the cost of treatment must include the loss in the tailing, which will vary according to the amount of ore taken and its consequent average richness.

This cost of treatment is capable of being ascertained by careful estimate for a number of cases, as for instance when two tenths of the ore or four, six, or eight tenths, or all of it, is being treated, and the tonnage cost in each case written down in the form of the curve NP (Fig. 2). By subtracting this from the curve LM we have a curve of net values RS, plotted to the same conditions as before, each point representing by its co-ordinates the net average tonnage-value, and the proportion of the total ore over which it may be taken, so that everything poorer than the corresponding ordinate of the assay-curve is left unstoped.

This curve RS (Fig. 2) has now to be superimposed upon the curve EF (Fig. 1), and it can then be seen at once whether the curves intersect at all, or whether they intersect at two points or at one.

The case where the curves EF and RS cut each other at two points is the more general one, and will be taken first. It is obvious that

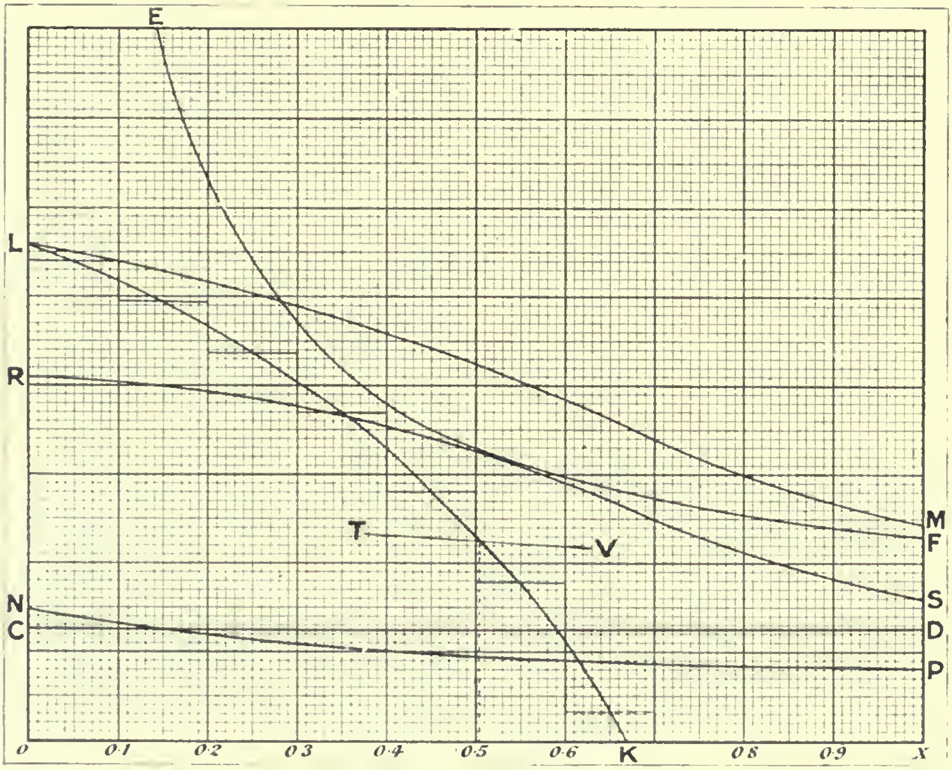


Fig 5. No Profit.

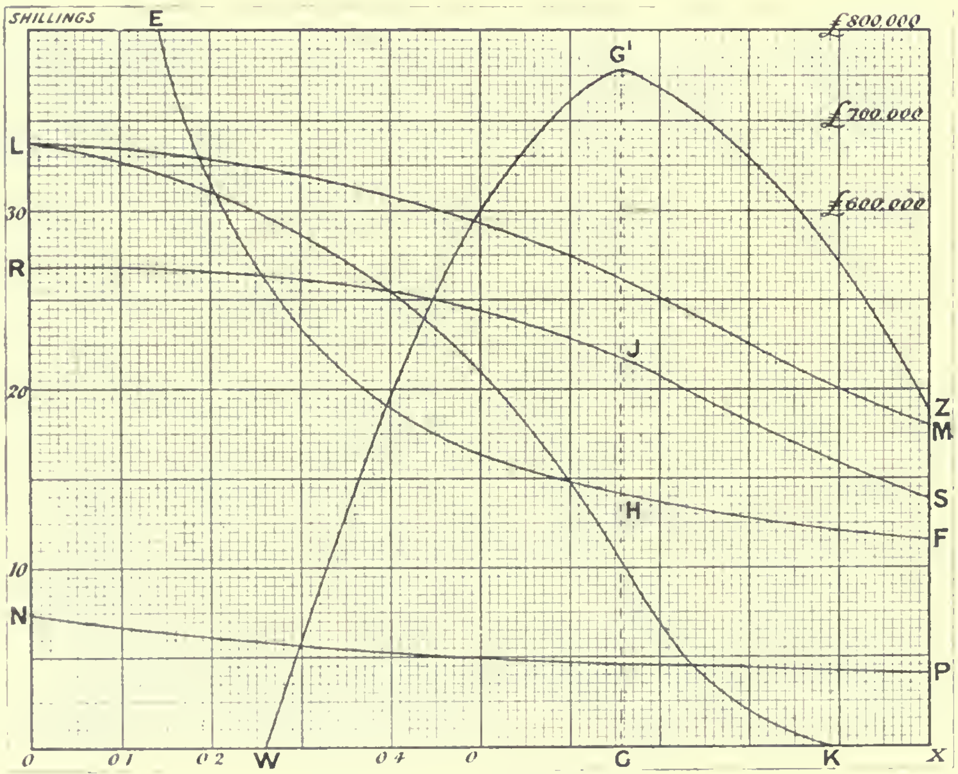


Fig 6. Profitable Case.

the part of the ordinate of *RS* (Fig. 3) intercepted by *EF* will represent a clear profit per ton after all charges have been taken into consideration, and that all ordinates that do not show any intercept, such as those outside the zone *WZ*, will be for proportions of ore stoped that will not give a profitable return, either on account of lack in the average value as taken over the large tonnage, or on account of lack of tonnage but with higher average values. It can be seen forthwith what proportion of the richest ore will give the highest tonnage-profit, for this is shown where the two curves have crossed to the greatest extent and are most distant as measured vertically; but this is not quite the information that is usually required. It is far more important to know the degree to which stoping must be performed to give the *maximum gross profit* with the particular characteristic assay-curve and cost, and a new curve *WG'Z* must now be drawn to show gross profits, each ordinate of which, such as at *GG'*, is proportional to the product of the intercept *JH* of the curves *EF* and *RS*, when multiplied by the tonnage, represented by the abscissa *OG*. This curve *WG'Z* thus needs a different vertical or money scale suitable to the conditions, and in the example (Fig. 3) it has been chosen arbitrarily at one four-hundred-thousandth part of the scale used for the tonnage-charges.

The ordinate such as *GG'* of the curve *WG'Z* now definitely represents the profit expressed in pounds sterling to be obtained by stoping the whole of the richer parts of the deposit as far as the proportion of the total ore indicated by the abscissa *OG* of the total curve *OX*. The curve itself is a characteristic profit-curve for the mining operations as conducted under the proposed conditions, and the position of its maximum point *G* at once gives the maximum profit so obtainable if there be no delay in getting the ore out. It also gives the proportion of useless ground to 'mill ore' in the lode, and, by reference to the corresponding point of the curve *LM*, the average grade of the ore in the mill; also, by reference to the assay-curve *LK* the minimum assay-value down to which ore may be stoped profitably. In practice, all these respective curves can be drawn on one sheet such as shown in Fig. 4. It will be seen that:

(1) 51% of the deposit must be stoped.
(2) The average ore value will be 23s. 2d. per ton.
(3) The lowest assay-value permissible from the mine is 10s. 4d. per ton.
(4) The entire cost on the ore will be 16s. 1d. in the mine and 4s. 10d. in the mill, making a total of 20s. 11d.
(5) The profit will be 2s. 3d. per ton.
(6) Excluding loss of interest owing to delay, the gross profit during 15 years will be £172,100, the immediate value of which may be taken from the usual tables when the rate of interest has been decided.

The case represented in Fig. 5 illustrates, on the same costs as those assumed for Fig. 4, how a rather smaller and different distribution of the assay-values gives a curve of net values that does not intersect the curve of costs at all. This simply means that there is no proportion in which it is possible to stope with profit, although, without the curves, the case would have been much more difficult to decide exactly. It will, however, be possible to recoup some, but not all, of the previous expenditure by stoping to the point represented by the intersection of the curve *TV*, representing the sum of the stoping and treatment costs, with the assay-curve; but some loss must ensue.

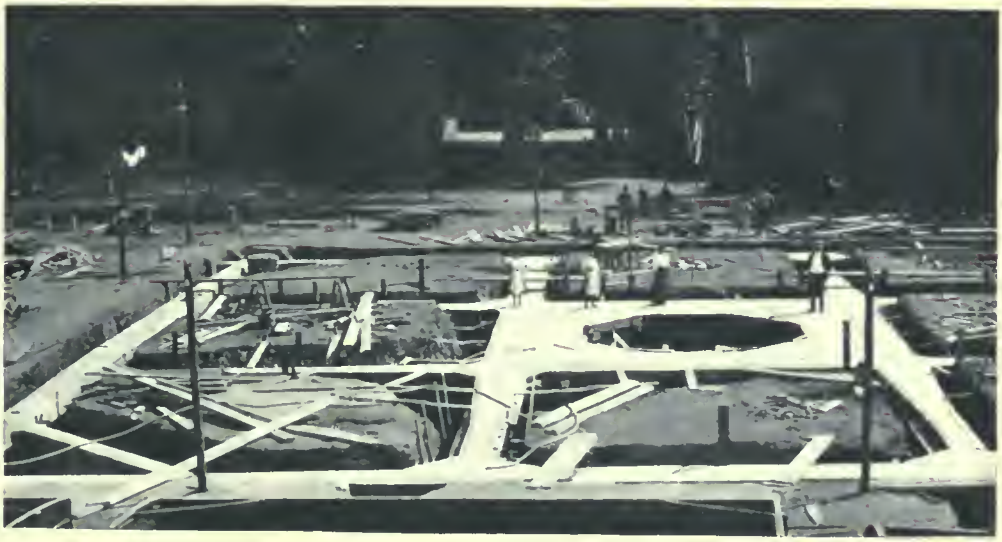
The third case is shown in Fig. 6, where a favourable characteristic assay-curve leaves no doubt concerning the possibility of ample profit, but only as to how far stoping should be carried. Such a mine would be one of the kind that proverbially 'makes the manager,' whatever his ability may be. It will be seen, however, that although the average of the entire lode is sufficiently high to show profits when entirely stoped out, and 71% of the ore is over the value to pay for the direct tonnage-costs, the true point of maximum economy is met when 34·2% of the lode is rejected and the average value of the ore sent to the mill is 26s. 2d., the minimum value of ore permissible to be stoped is 10s. 1d., the cost of mining 14s., and of milling 4s. 6d., while the profit per ton is 7s. 8d., and the gross profit over 15 years is £756,700 in round figures.

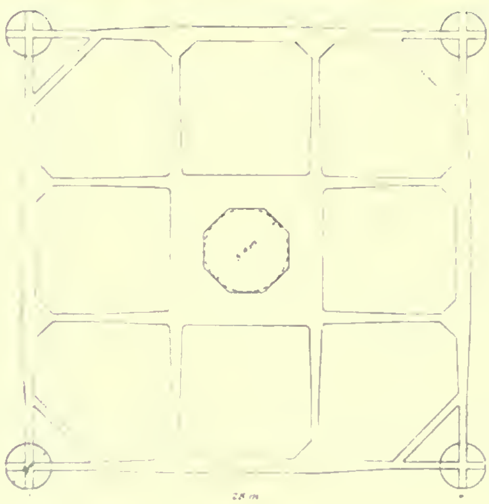
It may be noted that although the above graphic calculations refer in the main to a deposit that has been opened and sampled but not yet stoped, it is equally applicable to the cases *(a)* where the mine has been partly stoped, or, *(b)* where development is still in progress. The only modification necessary is the correct representation of the ore reserve at the time and the residual moiety of the development-charges after they have been credited with their share of such redemption of capital as has been effected during the previous stoping.

The convenience of having such curves redrawn from time to time when making up the accounts of the mine is obvious; the work of the mine can be reviewed thereby and adjusted in the light of the latest developments.

Shaft-Sinking in Dangerous Ground.

In our January issue we gave some information concerning the sinking of a new shaft at a coal mine in the north of England through treacherous ground, where the support for underhung shaft-lining was provided by a ring of reinforced concrete. An even more notable case of building the support in this manner is to be found at a colliery belonging to the Société des Mines de Houille de Marles, in France. Forty years ago one of the shafts at this colliery was practically destroyed by an inrush of water, and until last year it was considered impossible to re-open it owing to the broken condition of the ground at the mouth. It was not until M. Coignet of Paris came forward with a proposition involving the provision of a ferro-concrete structure that the difficulty was solved. As a matter of fact the structure partakes more of the nature of a system of steel girders than of ordinary reinforced concrete. The structure is supported on four masonry foundations arranged at the points of a square. These are 3 metres in diameter and are situated 28 metres apart. Upon these rest four main girders, and upon the latter rest four other intermediate girders. The platform for suspending the shaft-lining is built round the centre opening. The masonry foundations were built sufficiently far from the shaft-mouth to ensure stability. The four main beams are buried in the ground, as also are parts of the intermediate girders, but

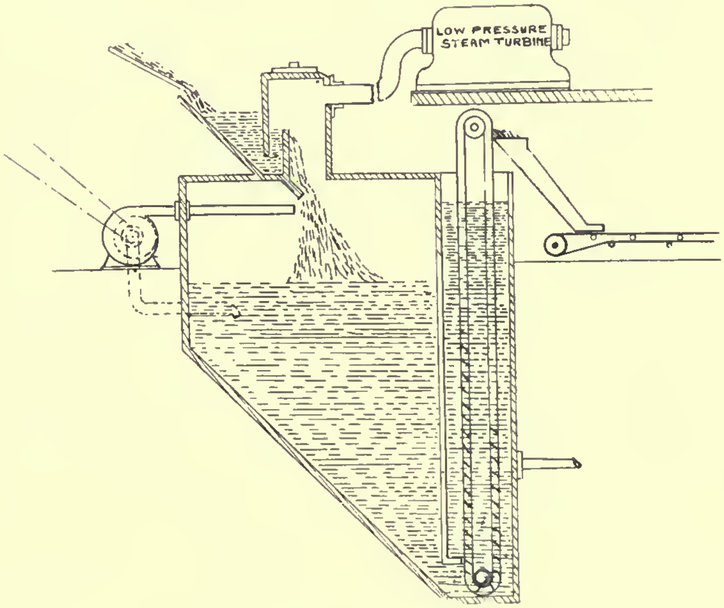




they are all made strong enough to do without the uncertain aid of the earth support. The depth of the beams is therefore made greater than would otherwise be the case, the main being 3 metres and the intermediate 2·7 metres. The steel framework of the beams is composed of round bars varying from 21 to 23 mm. diam. There are 28 such bars and their ends are bent upward gradually toward the points of support so as to resist shearing stresses. The web of the beams is made in a manner similar to that of an ordinary steel lattice-girder. The internal diameter of the suspended shaft-lining is 5·9 metres. The total weight of the ferro-concrete structure is 300 tons, and the weight of the underhung lining is 200 tons. In the photograph we show part of the completed work, and the small diagrammatic plan explains the shape of the structure.

Utilizing the Heat of Slag.

The heat of slag is not often utilized except in cases where the air-blast is warmed by contact with it. The application of this method of heating for the purpose of raising steam has not been considered seriously because it is impossible by means of it to obtain a steam much above atmospheric pressure; but the development of the low-pressure steam-turbine, which is operated by the power obtained by condensing steam, has drawn renewed attention to the subject. Claude Vautin has worked out a plan on this system, and in the accompanying sketch, which must not be taken as a working drawing, an outline of his method is indicated. The hot slag pours through a trap into the steam-raising-chamber, and as it falls it is disintegrated by means of a jet of hot water. This jet is projected by a centrifugal pump, which draws its supply from the hot water below. The granulated slag falls to the conical bottom and is raised by a chain-wheel up the side-chamber as shown.



In driving a steam-turbine it is necessary that no air should be mixed with the steam, and it is claimed that by this arrangement no air can get into the steam-raising chamber either through the pump that provides the jet, or through the apparatus that removes the slag. The chamber is kept steam-tight by means of the slag and water traps. The weights of 8 inches of slag and 2 feet of water in the respective traps balance a steam-pressure of 1 pound above the atmosphere.

Some idea of the amount of power generated by the slag will be obtained by the following considerations: With steam at atmospheric pressure, Mr. Rateau finds than on an average 32 lb. steam per hour gives one indicated horse-power. Assuming the feed to have a temperature of 17°C, the number of pound-calories per pound of steam at 100° C will be $(100-17)+$ (latent heat of steam or $536\frac{1}{2}$) $= 619\frac{1}{2}$. This multiplied by 32 gives 19,824, which represents the pound-calories per hour to give one indicated horse-power. As regards the slag, we assume its temperature to be 1300° C and its specific heat 0·2; then $(1300-100)\times 0{\cdot}2 = 240$ pound-calories per pound of slag due to specific heat. Add to this the latent heat of fusion, say 30 pound-calories, we get a total available heat of 270 pound-calories. This multiplied by 2240 gives 604,800, which is the number of pound-calories per ton of slag. Dividing 604,800 by 19,824, we obtain 30·5, which gives the indicated horse-power obtainable from one ton of slag per hour. This figure supposes that there is no loss of heat anywhere.

Many mechanical considerations in connection with this idea will have to be determined in practice.

Solubility of Gold. — Richard Pearce, at a recent meeting of the Society of Chemical Industry, gave some account of experiments he had made with the object of finding out if water containing minute quantities of sodium chloride and free sulphuric acid would dissolve gold. These conditions are found frequently in mine waters. The experiments were made on a Cripple Creek ore taken from near the surface, that is, an oxidized telluride in a silicious gangue and associated with psilomelane and limonite. The fine ore was digested for some days with the acidulated saline solution, with the result that some of the gold was found to be dissolved. The solution was then allowed to act on crystals of iron pyrite, and after some weeks minute rosette crystals of gold began to make their appearance on the pyrite. This experiment might explain the change in veins in which the gold has been transferred by solution from the oxidized portions of the veins to the pyrite ore below, so forming a secondary enrichment.

TIN-DRESSING

By H. W. HUTCHIN

During the recent boom in Cornwall it became not unusual to appoint chemists upon the staff. Hence the adoption of wet methods for the determination of tin. My own experience having been of this nature, I have tried to present the results of a mine equipped with modern plant during a dividend-earning period in a manner that avoids the intricacies of tin-dressing operations. I have also adopted the practice of reporting wet assays in terms of metallic tin, while in the case of vanning, the black tin is reduced to metal by calculation based on a wet assay of the vanner's concentrate.

The simplest form of tin-dressing and the one in which the operations are best controlled is the method of vanning. With a given sample of ore it is easy to arrive at the value by a direct wet assay and compare this with the calculated value based upon the wet assays of the black tin obtained and the tailing from the vanning-shovel. As a precaution, whilst the vanning was done by the mine vanner, the weighing of the ore and the concentrate obtained were made personally and with balances of suitable accuracy. Recognizing that one vanner may differ from another, it was necessary to arrive at some idea of this particular vanner's constancy or otherwise. Under these conditions on six assays of a sample of battery pulp his results were 14·16, 12·8, 14·5, 14·88, 14·88 and 14·4 lb. black tin, equal to an average of 14·27. His concentrates contained 46% metal, giving a recovery of 6·56 lb. metal per ton; by wet assay the sample contained 18·75 lb., leaving an inferred loss of 12·19 lb. in the tailing from the vanning-shovel.

On seven samples of battery pulp representing daily samples of a week's run of the mill, the vanner returned 16·25, 19·25, 18·5, 19·0, 16·0, 22·4, and 19·8 lb. black tin, equal to an average of 18·75 lb. This black tin contained 46·2% metal; thus the 18·75 is reduced to 8·66 lb. metal per ton; the combined tailings of the seven vannings contained 10·5 lb. metal per ton (wet assay) giving a total calculated value for the average samples of 19·16 lb. metal per ton. The wet assay of the average sample was 19·5 lb. Similarly on another lot of six samples of the same character the vanner returned 27·2, 49·75, 31·7, 40·1, 35·8, and 16·8 lb. black tin, or an average value of 33·5 lb., which at 46·2% metal is equal to 15·44 lb. metallic tin per ton. The net tailing assayed 14 lb. metal per ton, giving a total value for the average ore of 29·4 lb. per ton. The content by a direct wet assay of the average ore was 29 lb. An average sample of these six was classified by screens and proportional parts of the screened products were vanned separately, involving in all seven vanning assays. By this method the vanner returned the ore at 39·7 lb. black tin containing 43·4% metal, making it equal to a recovery of 17·2 lb. metal per ton and leaving a loss of 12 lb. per ton in the tailing.

	I. 14 mesh	II. 16 mesh	III. 20 mesh	IV. Black Tin	V. Wolfram
On 60 sieve, %	30·3	28·3	19·5	8·9	1·8
On 120 ,, , %	19·7	21·9	16·0	19·4	16·2
On 200 ,, , %	12·7	10·3	14·5	16·9	24·8
Through 200 sieve, %	36·7	40·6	49·5	56·8	54·4
Assay of original, lb	17·5	18·5			
,, fraction through 200, lb	22·25	23			
Total tin in the *minus* 200 fractions, %	46·6	50			

The battery pulp used in these experiments was produced by 1050 lb. Californian stamps discharging through 20-mesh wire woven screens. Reference to the screening tests, given in the table, of samples of pulp when using 14, 16 and 20-mesh screens, accompanied by the assays of the original samples and the portions passing 200-mesh sieves, show that even with the coarser crushings approximately 50% of the total tin content is contained in the portions passing a 200-sieve. The screening tests of black tin and of wolfram recovered from similar ore confirm this.

As with the vanning assay, so with a tin-dressing plant, the operations may be controlled in two ways: (1) by the direct determination of the tin in a number of systematic and continuous samples of battery pulp, or (2) by the calculated value based upon the weight and assay of the various tailings, and the weight and assay of the concentrates. It is most necessary to use both methods. Neither method is so easily controlled as in the vanning assay; the direct method assumes that the small fraction of ore represented by the pulp-samples is of precisely the same value as the bulk from which it is taken; the 'calculated' or indirect method presents difficulties in forming an estimate of the relative proportion of tailings of different values; if the real tonnage be greater or less than the nominal tonnage both methods are affected, but diversely.

In practice the tailings of a tin-dressing plant separate into two main groups: (1) the 'tailings from the battery' resulting from the first concentration preliminary to calcination, (2)

TONS OF ORE CRUSHED.

Tons		Pounds of Metal
692	Wet black tin + smelter's allowance ..	1,001,116
142	Wolfram	12,200
44	Waste products sold....	6,000
830	Calcination loss (arsenic, sulphur, etc.)........	Nil
3,700	'Tailings from tin yard' at 17 lb. per ton	62,900
54,092	'Tailings from the battery' at 7 lb. per ton ..	378,644
59,500	Ore	1,460,860

the 'tailings from the tin yard,' comprising the waste in the concentrations following calcination.

The former constitute the larger proportion of waste and unite automatically even though separated initially by classification. The valuation of them is not difficult if due precaution be taken in sampling. The 'tailings from the tin yard' are naturally less in quantity but higher in value than the former; the net loss from this portion of the operations is small in comparison to the loss in the first concentration. The balance-sheet that I should present for a 12 months' run would be:

The value of the ore calculated from this statement would be 24·5 lb. per ton; the value by wet assays of pulp samples being 22·5 lb. The recovery works out at 16·8 lb. per ton, with a net loss of 7·4 lb. in tailings. By comparison with the vanning assays the work of the dressing-plant is superior and from this standard wins our admiration, even if it falls short of the ideal. Are not the conditions attending the extraction of tin analogous to the conditions on the Rand before the introductions of the cyanide process? The remedy now, as then, is not apparent but may be found by properly directed effort. Let our mines co-operate to the attainment of this purpose.

The Carat.

L. J. Spencer, assistant in the mineral department of the British Museum, entered a powerful plea for the adoption of the metric carat to be used for measuring the weight of diamonds and other precious stones in a paper read at a recent meeting of the Mineralogical Society. The paper contains a review of all the different alleged weights of the Cullinan diamond as published in both the technical and popular Press, and a historical discussion of the various carats and of their origin. The inaccuracies of measurement or rather of statement may be seen from the fact that people of high authority give the weight of the Cullinan diamond anywhere from 3024 carats to 3253¾ carats, the first being given by Kunz in 'Mineral Resources of the United States' and the latter by Wodiska in his recently published 'Book of Precious Stones.' In avoirdupois weight the authorities vary from 1·37 lb. (Hatch & Corstorphine) to "about 1¾ lb." (British Museum Guide): while in French weights the variation is from 610 grammes (Max Bauer) to 676½ grammes (*Nature*). Mr. Spencer, after careful enquiry and examination, considers that the actual weight was 3025¾ English carats or 621·2 grammes when weighed in air against brass weights. Mr. Spencer proceeds to give details of the various carats in use and mentions that the British standard is 205·304 milligrammes or 3·1683 English grains, that is 151½ carats to the ounce troy. This standard was fixed by the Standards Department of the Board of Trade in 1888, but in books on precious stones, the English carat is usually given as 205·409 milligrammes. E. W. Streeter and Gardner F. Williams, in their respective books, say that a carat is equivalent to 4 grains avoirdupois or 3·174 grains troy; though, of course, the troy and avoirdupois grains are identical. The dealer in precious stones divides his carat into 4 'diamond-grains,' and there is the 'pearl-grain' of which 600 go to the troy ounce. Mr. Spencer recommends the abandonment of all measures for the metric carat of 200 milligrammes.

It is generally supposed that the carat was derived from the weight of hard leguminous seeds. The Greek name was keration and the Latin siliqua, and the seeds of the locust-bean named by Linneus ceratonia siliqua are found by Mr. Spencer to average 0·197 grammes or 3·04 grains and are remarkably constant in weight. At the present time the seeds of another plant, the rati, are used in India by the goldsmiths for weighing gold.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Conversion Factors.

The Editor:

Sir—Mr. W. J. Sharwood's valuable articles upon 'Measurement of Pulp and Tailing' have placed his metallurgical fellow-workers in all parts of the world under great obligations. After so exhaustive a discussion of the subject but little remains to be said beyond acknowledgment of their value. I venture, however, to add a few forms of conversion factors that I have found useful, and which are readily remembered:

1 gramme per litre	= 1 oz. (avoirdupois) per cu. ft.
	= 2 lb. per fluid ton of 32 cu. ft.
1 gramme per metric ton	= 14 grains per 2000 lb. ton.
	= 7/12ths of dwt. per fluid ton of 32 cu. ft. of solution.
	= 1 mm. per litre.
1 dwt. (approx.) ...	= 1 U.S. dollar.
	= 2 pesos (Mexican).
	= 4s. 2d.
0·01 dwt. (approx.)	= 1 U.S. cent.
	= 2 centavos (Mexican).
	= 1 half-penny.
1 millieme of gold fineness (approx.)	= 1d. per oz. of bullion.

Although 32 cu. ft. pure water do not weigh quite 2000 lb., yet in practice the higher specific gravity of working cyanide solutions tends to counteract the error and in any case the usual limits of accurate measurement renders it negligible.

W. A. CALDECOTT.

Johannesburg, February 14.

Labour in Mines.

The Editor:

Sir—Having for the last seven years had an extensive experience with Asiatic mining labour, mostly Chinese and Koreans, I have followed the discussion in your Magazine with much interest.

I do not think that the possibilities of such labour, employed in its native country, has been sufficiently recognised, especially as pointed out by Mr. Shockley, under a management fully conversant with the language and customs of the country in which they are working. In my opinion, one of the main obstacles in the way of obtaining good results from such labour lies in the difficulty of securing suitable white superintendence.

On this property, during last month, the average contract price paid for all drifts and winzes was slightly under eight shillings per foot. All work was done on contract with Korean labour, working in three eight-hour shifts. The contractor paid for all labour, explosives, steel, tools, and candles, and also did all trucking and hauling from winzes, laid all tracks, stacked all ore on dump, and kept the working mouths clear of ice, which latter is at times quite an item here. The price paid by the contractor for all supplies is the cost of same laid down at mine, including cost of pack-pony transport over a rough trail of 90 miles from the sea-coast. The contract is exclusive of white supervision, the cost of all mine-timber, timbering, and tool-sharpening. The country rock in which practically the whole of this work has been done, consists of the typical Korean Paleozoic limestone, which is of average toughness and hardness. Drifts and winzes are of the usual dimensions. The average rate of progress made by the Koreans here is 100 ft. per month in drifts, and from 50 to 60 ft. in winzes.

One point that should be taken into account when comparing white and coloured labour in mines, is the freedom from strikes which has so far characterized the latter, also the fact that with the exception of a week or ten days of holiday at their New Year, the Chinese and Koreans are quite contented to work continuously for the remainder of the year.

A. R. WEIGALL.

Kapsan Mine, Korea, February 19, 1910.

Mining in Siberia.

The Editor:

Sir—Your correspondent, Mr. John M. Nicol, of Mexico City, is mistaken. He should be glad of an excess of work in Mexico so that he will feel no temptation to "run over and see" conditions in Siberia. When this temptation arises he will save time by opening his Siberian negotiations at St. Petersburg, employing a lawyer, an ex-attaché, a professor of languages, and one of psychology, and taking a six months' lease on a suite of apartments in the Hotel Europe.

Then after purchasing some necessary supplies, including a few pounds of insect powder and folding toilet accommodations, he will be equipped for the Lena and the Stanovoi. At Bodaibo he will be welcomed with open arms by Mr. Byeloseroff, the manager of the Lena Company, and his five thousand men. They will march him up the hill, and march him down again. It might be well for him to include a small expense account with his $50,000 annual stipend, or it will probably not last more than fifty thousand minutes.

$10·70 per cubic yard is not fabulously rich ground for the Olekma and Vitim districts, generally referred to as the Lena; in fact, since the workings commenced in 1844 such values have been maintained on several of the claims, and sometimes exceeded. For example, the Uspenski claim located in 1864 on the Akanak-Nakatami creek, now operated by the Vitim Banks Co. has produced 2750 poods, or over $25,000,000 from 2,400,000 cubic yards of gravel. The Rozhdestvenski, located by a woman, Agnes Kasatkin in 1867, on the Nakatami, has produced $15,000,000 from 1,000,000 cu. yds. Of these facts, Mr. Nicol can satisfy himself by referring to the excellent statistical reports prepared by Guerassimof, Sadovnikof, and others, concerning these mines, from official data recorded ever since Michael Sibiryakof located the first claim on the Nakatami in 1863.

With regard to the case quoted in the annual review issue of the *Mining and Scientific Press*, as I was responsible for and conducted this operation, I can assure Mr. Nicol that 90% of the material was tailing, but some patches of unworked gravel were encountered underneath, which increased the recovery. From tailing itself the recovery was from 50 to 80c. per cu. yd.

There are good men in California, and the world takes off its hat to them as placer miners; but California is a small place, and her expert miners must find occupation elsewhere, if they are to pursue their classic vocation. Siberia will perhaps be the twentieth century California.

C. W. PURINGTON.

London, March 17, 1910.

The Editor:

Sir—It is impossible to let your article in the March issue pass without comment. From your point of view it is intended to stir up the Russian officials (and indirectly the Government) and to convert them to English methods and ideas. From their point of view (should the article be translated and widely circulated) it is offensive and will, I fear, stiffen the backs of officials to insist on a more rigorous compliance with the law.

I ask you, Sir, you who have travelled the wide world over, and gained that breadth of view that is never gained by those who live their lives in their native country, to put yourself for a moment into a Russian mining official's skin. He is given certain laws, framed most laboriously and in great detail, for which he is in no way responsible, and these he is paid to see carried out not only by his own people but by any foreigners who are working in his district. No complaints are made by his own people, who number 999 to one foreigner, but that one foreigner, who in his own country loudly calls for respect and compliance with *his* country's laws, gives in Russia more trouble than all the 999 citizens, and then (from the Inspector's point of view) adding insult to injury writes:

"It is high time to ascertain clearly whether Englishmen and Americans are to be deemed intruders."

"At the mercy of any Inspector that happens to be corrupt or stupid . . . .; the second is more dangerous."

"The unintelligent interference from a mob of inspectors, sub-inspectors, and other petty officials."

"Such outrages ought to be made widely known."

"It is high time . . . . to unite in a concerted effort to obtain . . . . freedom of action."

May I refer you to Luke xviii, 9, and following verses: "I thank Thee that I am not as other men are."

We Anglo-Saxons find it impossible to fall in with the laws and customs of any country other than our own, and our prestige is such that in four-fifths of the world people, for the sake of peace, let us have our own way; but in the other fifth, the mighty Russian empire, we have run up against a snag against which our dynamical forces are not going to prevail.

No, Sir, we are foreigners once we land on Russian soil, and it behoves us to trim our sails to the wind of common sense. We do not go there as helpers or as developers of Russia's resources; we are not philanthropists; we go there to secure a slice of Russia's vast mineral wealth for ourselves, and that the Russian fully understands.

What are the complaints? They are:

(1) The Inspector is empowered to appraise the value of beef, and this he does regardless of market costs.

(2) On the Lena, the Russian manager is authorized to receive a commission on the gross output of a mine.

(3) The miners help themselves to nuggets, which they re-sell to the Company at half-price.

(4) The Government Inspector can shut-down any mine by compelling the manager to comply with the laws.

(5) The Ispravnik confiscated $10,000 worth of gold belonging to an American in 1908.

To these complaints I venture to say:

(1) Once a year a revision of the prices at which stores may be sold to workmen is made by the Government Inspector, to protect the workmen. The manager of the mine, by taking the trouble to send a careful statement of the costs of these stores *before* this revision, to the Inspector, can get the tax so fixed that no loss whatever is incurred. If, however, he waits and ignores or forgets the revision, the Inspector naturally makes his own estimate. Then when it is too late the manager wakes up. I have personal experience of that little catastrophe.

(2) A matter of private arrangement between the Company and its officials apparently, or a condition of the original concession, your article does not say which.

(3) Gold is stolen in other countries besides Siberia, *all* of which is a total loss to the owners. I admit gold stealing in Siberia is a curse, but you must take the people as you find them, and as at Kimberley and elsewhere, exercise more stringent control. The officials, police, and engineers will give you every assistance, but the Company must help itself; the vastness of the country makes the policing of it as in England an impossibility. Surely it is better for the Company to buy back the gold at half-price than to lose it altogether.

(4) The Inspector has laws to enforce, and he is specially bound to prevent accidents. Often his judgment of what is necessary to safety is at variance with ours. We have a reputation, on account of the terrible accident-rate on the Rand, for a recklessness of human life; this makes the Inspector very stringent with the English managers. The trouble will correct itself in time, but at present the foreign-managed mines in Russia show a higher accident-rate than those managed by Russians.

(5) Of this complaint some more details are required. There is evidently more behind. Siberia is dotted with highly trained judges and magistrates, men completely beyond fear or favour, and the Courts are open there, as here, to rich and poor. If a robbery is committed, as is suggested, an appeal to the Supreme Court at Blagovestchensk would have made that Ispravnik sorry he spoke.

Yes, Sir, Russia and Siberia are open to our capital and enterprise, and we can, by our industry and energy, reap vast fortunes for ourselves out of them. But we must conform to the laws as we find them, and not heap abuse on highly educated gentlemen who are paid to carry them out. Let us learn the language, study the laws, and conform to them; then all difficulties vanish, and courtesy to the controlling Inspectors will induce them to stretch such freedom of judgment as is accorded to them by law to its utmost extent. Will your article have this effect?

WALTER J. STANFORD.

London, March 30.

Dredging for Gold.

The Editor:

Sir—This discussion started with comparisons between the cost of operating English or New Zealand dredges, on the one hand, and American dredges, on the other, but some of the correspondents have gone a little wide of the mark, notably 'Kotuku' in the *Mining Journal*. The fault of many New Zealand builders lies in the claim that their design is suitable for all classes of country, and I am inclined to think that some of the American designs are going to err similarly, in assuming that the heavy expensive big-capacity American dredge is the only one worthy of consideration. My point of view is that with ground such as that on the Klondyke and Fraser rivers, light dredges are a failure, whereas with shallow deposits of wash, like much of the ground in West Africa and New Zealand, the heavy American type is equally a mistake. If the wash is shallow and rich and a 4-ft. bucket can only be half-filled, there is no object in using one of 13 ft., but on the Fraser river and in the Yukon a light belt of buckets is absolutely useless. Again, if the gravel has only a value of 6d. per cubic yard, a dredge working at the cost of 7d. spells disaster.

It is not always necessary to make a big-capacity dredge with heavy working parts, as the wash may be fine, containing no large stones, and therefore causing little strain. On the other hand a 4 or 5 ft. bucket dredge may require to be of the heaviest construction on account of the tremendous strains to which it is subjected, on the Fraser river for instance. The common mistake is to send out dredge-designers without the experience qualifying them to report on alluvial properties.

A source of expense and trouble on a dredge is the elevator. In many cases this class of dredge is put on where an ordinary sluice-box would be more suitable. I know of a case where a sluice-box dredge was designed, built, and sent out, to deal with wash that contained stones and rocks that could hardly pass through the hangers, clearly proving either ignorance or carelessness.

I agree with Mr. Purington that it is better to err on the side of providing a dredge too heavy for light work, than one too light for heavy work; the former will do the light work all right, but the latter is useless and would be the cause of failure; yet why pay £15,000 for a dredge if £7000 will do?

Every dredging proposition must be treated on its own merits; fuel, transport, quantity and value of the wash being the main factors that determine the class of dredge necessary for the work.

With regard to the use of the head-line or the spud, it is again a question of suitability. If a head-line can be used, by all means have it, because it is cheaper, and the dredge can be handled with greater nicety; but if there is a high face, the spud must be used, although it is rough on the machinery and increases the cost of repairs.

JAMES HOWLISON.

London, March 5, 1910.

The Editor:

Sir—In reply to the query of Mr. W. H. Cutten on page 220 of *The Mining Magazine* for March 1910, where he asks for "the name of any American type of dredge working outside the American continent that is paying its way," I can reply that if he will look in the *Transactions* of the American Institute of Mining Engineers for 1906 he will find on page 327 (Vol. XXXVII.) a picture of a dredge of that description working profitably on the Ivdell river in the northern Ural. This is a close-connected dredge with 3 ft. buckets, built in the Putiloff works at St. Petersburg from plans furnished by the Bucyrus company, and I think that a portion of the machinery was made in the United States. In the article accompanying the illustration mentioned there is a short description of the working of this dredge. I last saw it on October 6, 1905, a few days before its first season's run was ended, and at that time the profit was estimated at 65,000 rubles (or £6500) for the season. I never heard the exact amount of the profit, but I understand that subsequently a 5½-ft. dredge of the same type was built, and that both these dredges have paid well.

The results of the working of these two dredges for 1908 is published in 'Gold and Platinum,' the official newspaper of the Permanent Consulting Office of the Gold and Platinum Producers, in the September 15/28, 1909, number. I take the following particulars from a table in that issue showing the results of the working of 49 dredges in Russia and Siberia for 1908.

DETAILS OF IVDELL DREDGES.

Size of buckets	Worked for Days	Worked for Hours	Yards Excavated	Ounces of Gold Produced	Yield in pence per cu. yd.
No. 1, 3 ft.	192	3783	156,210	1659	9·4
No. 2, 5½ ft.	184	3283	256,159	1962	6·8

Work began on April 4/17 and ended on October 19/2, 1908. The estimated cost of running a dredge in the Ural region is about £3000; thus it is seen that the No. 1 dredge earned about £3000 profit, and No. 2 about £4000. These are only approximate figures, as the fineness of the gold is unknown.

I am informed by a Russian mining engineer that there are two dredges of the American type working on platinum deposits at Nijni Tagil and paying handsomely. My informant also tells me that there are a number of similar dredges—of Bucyrus type, but made by the Putiloff works—operating on the gold placers of the Northern Taiga in the Yenesei government. I note that one of these dredges produced in 1908 over 5½ *poods* of gold, which should mean a profit of some £5000.

Russian engineers with whom I have talked seemed to be in favour of this type of dredge. There is, however, some question as to the relative advantage of the close and open-connected buckets: a number of engineers favour the open type.

W. H. SHOCKLEY.

London, March 30.

Golden Horse-shoe.

The Editor:

Sir — In your September and December numbers a professional speculator classes Horse-shoe shares under the heading of 'Investments and Speculations' as "excellent." If you publish such a list again, I think this classification of Horse-shoes cannot hold good any longer.

I desire to point out that the monthly returns of this mine suddenly and unexpectedly dropped from 11,320 oz. in December 1909 to 6551 oz. in January 1910, recovering in February to 9421 oz. The peculiar feature of the occurrence is that there was no decrease in the tonnage, but only in the average yield of the ore treated; and that the manager recovered only 22s. 4d. per ton the very same month when he estimated having over one million tons of 47s. ore in reserve! Knowing that the manager used to have a bullion reserve to equalize fluctuations in the monthly returns, I consider the low return all the more inexplicable. Surely there must have been something radically wrong at the mine.

The most annoying circumstance however lies in the fact that the London management simply stated the fall in production to be "due to unavoidable causes," refusing to give any further explanations, and avoiding to give an explicit answer when pressed by shareholders. This procedure is reminiscent of the old days when West Australian mining was stinking in the nostrils of the public.

THEODOR RUBISCHUM.

Zurich, March 30.

[This protest is warranted. Whatever reason there may be for the sudden drop in production, there is no excuse for the lack of an explanation on the part of the management. The shares of this mine are largely held in France by individuals not well able to make forcible objection to such disregard of their susceptibilities.—EDITOR.]

Rock-drills.

The Editor:

Sir—Thinking that figures showing the comparative cost of the work done during a month's trial by the Ingersoll-Rand hammer-drill, the ordinary 3 in. percussion rock-drill, and hand-drilling, might interest some of your readers, I have pleasure in enclosing them herewith.

The trials were most carefully carried out at the Sotiel mine, in Spain, the property of the United Alkali Co., and the results were somewhat surprising.

One reason why the Ingersoll-Rand drills were enabled to break a larger quantity per hour undoubtedly is that the holes can be bored in much more suitable places and with greater facility than is the case with the ordinary percussion drill.

ALEXANDER HILL.

London, March 30.

[Having heard of this competitive trial, we requested Mr. Hill to give us the figures for publication. They give information valuable to mine-managers.—EDITOR.]

RESULTS OF A DRILLING COMPETITION AT A COPPER MINE IN SPAIN.

	Tons broken per hour	Horse-Power per hour	Cost: Pesetas per 1000 Kilogrammes. Wages	Explosives	Repairs	Lubrication	Compressed air	Steel	Amortization	Total
INGERSOLL-RAND HAMMER-DRILL	3·045	10	0·757	0·661	0·060	0·022	0·820	0·117	0·230	2·667
3 in PERCUSSION ROCK-DRILL	1·10	12	1·702	2·096	0·469	0·036	1·474	0·171	0·200	6·148
BY HAND Two men	0·243	—	5·503	0·726	—	—	—	0·060	—	6·289

Flotation Patents.—Several new patents relating to the flotation process identified with Minerals Separation Limited have been published. One of them is numbered 4911 of 1909 and is granted to Theodore J. Hoover. This relates to an improvement in the mechanical details of the process. The churning of the pulp, after the addition of acid and oil for the purpose of producing a froth, is effected in a series of tanks, and the mixture is discharged from the last tank into the spitzkasten at a point below the level of the water in the latter. There is also a baffle plate arranged in the spitzkasten at an angle, and this causes the stream of churned pulp to flow into the spitzkasten in an upward and inclined direction. In this way the mineral caught in the scum is enabled to rise to the surface with the least resistance from the gangue and with the full advantage of the imprisoned air. Patent 26852 of 1908 is granted to A. H. Higgins of Broken Hill and Minerals Separation Limited, and it covers the use of chemicals of the carbolic acid group in place of the usual oil. A third patent 2359 of 1909 is granted to H. H. Greenway, H. L. Sulman, and A. H. Higgins, and claims the use of other organic compounds such as amyl alcohol and amyl acetate. The former is the chief constituent of fusel oil. Comparatively minute quantities of these chemicals are required to effect the frothing, as little as 0·1% being mentioned.

PERSONAL

R. T. BAYLISS sails for New York on April 20, to meet R. M. RAYMOND from Mexico.

FRANCIS P. BRAY has returned from West Africa.

L. N. B. BULLOCK is at the Abosso mine, in West Africa.

HERBERT T. BUTCHER is in Algeria.

F. T. BYRDE is expected on his return from French Guinea.

W. A. CARLYLE is in Norway.

W. J. COX, manager of the Camp Bird, and recently appointed advisory engineer to the Santa Gertrudis company, has been in London.

J. H. CURLE has returned from South Africa.

GODFREY DOVETON is in the Hostotipaquillo district of Mexico.

A. E. DRUCKER sailed for Korea from San Francisco on March 15.

WILLIAM FRECHEVILLE will arrive at Marseilles on April 19, returning from Pahang, and will spend a few weeks in Spain.

A. D. GASSAWAY is on his way from the Lena goldfields to London.

NORTON GRIFFITHS, BRUCE MARRIOTT & CO. have moved to 59a London Wall.

C. V. HAINES is on his way to South America.

ROBERT T. HILL made a flying trip to London in the last week of March.

VERNON D. J. HOAR, lately at Tonopah, has gone to Barberton, in the Transvaal.

JAMES HOCKING, formerly at Broken Hill, is the new manager of the St. Ives Consolidated mines, in Cornwall.

L. H. L. HUDDART is returning from Southern Nigeria.

J. POWER HUTCHINS is at St. Petersburg.

WALTER P. JENNEY is visiting New York.

H. F. JULIAN sailed for New York on March 23.

JAMES F. KEMP has been elected president of the New York Academy of Science.

R. B. LAMB has returned from Costa Rica and is now in Chihuahua, Mexico.

HENRY P. LOWE is here from Colorado.

H. F. MARRIOTT is due from South Africa about April 25.

T. BRUCE MARRIOTT left London on March 19 for South Africa.

E. T. McCARTHY was recently at St. Petersburg.

H. F. MUNROE, manager of the Oriental Consolidated, was at Paris recently and is now at New York.

JOHN F. NEWSOM has resigned his professorship at Stanford University to engage in engineering practice.

FRANK W. OLDFIELD is at Guadalajara, Mexico.

R. A. F. PENROSE was in London recently.

C. W. PURINGTON sailed for New York on April 9. He will leave San Francisco for Eastern Siberia on or about May 14.

CHARLES H. RICHARDS is now superintendent of the Nundydroog mine, India.

H. B. RICHARDS has sailed for West Africa.

FRANK RICHMOND, lately at the Broomassie mine, West Africa, has returned to England.

T. A. RICKARD has been appointed occasional lecturer on mining geology at Harvard.

FRANK G. A. ROBERTS sailed for Johannesburg on April 9.

JOHN SAXTON left for the Gold Coast on April 6, as manager for the Eastern Akkim Ltd.

HAROLD SHARPLEY is on his way to Brazil, having sailed on March 30.

CHARLES F. SHELBY has been appointed smelter superintendent for the Cerro de Pasco company in Peru.

R. DE H. ST. STEPHENS has returned from Jamaica.

J. W. TEALE is going to Western Australia, to open a branch office for Bainbridge, Seymour & Co.

W. TRURAN is now with Hooper, Speak, & Feilding.

R. A. VARDEN is due from Brazil.

F. H. WALSH has left Guanajuato and is now with the Santa Gertrudis, at Pachuca.

FRED. WARTENWEILER, recently at the Homestake, sailed for South Africa on March 11.

COMPANY REPORTS

San Francisco del Oro.—The directors have issued a report announcing their intentions with regard to the new system of treatment to be adopted. It will be remembered that the company was formed in 1903 for the purpose of acquiring the mines situated 14 miles to the southwest of Parral, Mexico. The surface ores were profitable to local owners who treated the carbonates for the gold and silver contents. Subsequently sulphides prevailed, and the ore became a mixture of blende, galena, and pyrite. It was attempted to smelt this complex mixture in the Mexican furnaces, and subsequently some was picked and shipped, but the owners decided eventually to sell and to leave the burden of solving the metallurgical problem to other people. The English company, which then took hold of the property, found their way beset with difficulties, and several methods were tried, such as chloridizing-roasting. There was always some rich ore that could be shipped, and enough has been sold to pay current expenses. This policy, however, was considered bad, for not only did it mean leaving much ore behind, but the cost per ton of extracting the rich ore was made high owing to so much unsaleable ore having to be mined as well. It was in those days impossible to concentrate by jigs owing to the scarcity of water, and a trial was made with a dry table. This was a failure on account of the large amount of middling produced. Then a stroke of good fortune came to the mine in the form of an inflow of water at the lowest level, and thus the mine was provided with a regular supply of 220 gallons per minute. It was accordingly decided to adopt water-concentration of the usual type, and with large ore reserves it was felt justifiable last year to raise the necessary capital by reconstructing on the basis of an assessment of 3s. on 330,000 shares. It was known that by jigging a lead concentrate of good quality could be obtained, but the question was to evolve a method of dealing with the zinc content. About 60% of the ore is sulphide, and 40% gangue, which latter consists of quartz, slate, calcite, and fluorspar. Of the silver content 50% is in the blende, 35% in the galena, and 15% in the gangue. The sulphides are intimately mixed and their separation involves the production of much slime. Experiments with one of the flotation processes gave too high a consumption of acid owing to the calcite, while the fluorspar diminishes the value of the zinc concentrate. The latter is not liberally treated by buyers in the matter of silver content, not more than 50% being paid for. Seeing that so much of the silver of the ore is in the zinc product, it is obviously to the advantage of the company to treat this product itself eventually.

The experimental operations have been conducted by Percy Tarbutt & Co., consulting engineers, W. S. Harrison, manager, and James Wilding, consulting metallurgist, on ore brought over to the Emu works near Swansea. It is reported that the smelting of the zinc products can be satisfactorily effected. A good extraction of the zinc and silver is obtained and the fluorspar content has been reduced toward the required maximum. There are, however, many details still to be settled in connection with the zinc metallurgy, and the company has in the meantime wisely accepted an offer from a firm of smelters to purchase the zinc product. The terms of purchase will be sufficient to yield a small profit, and, for a time, and until the company erects a smelter of its own, the solution is a satisfactory one.

The company will immediately proceed to erect a concentrating plant of sufficient capacity to treat 300 tons per day. This and the necessary outlay on power and extension of the railway will cost £46,000. With zinc at £20, lead at £13, and silver at 2s., the production of lead and zinc concentrates is expected by the engineers to yield an income of 37s. 6d. per ton of ore, and the total cost of mining and concentration is estimated at 16s. 6d., but close figures are not given in the report.

Giroux Consolidated.—This company owns copper mines in Mexico and Nevada. The Mexican properties are known as the Sultana group and are situated in the Ures district, Sonora. In previous years high-grade gold-bearing copper ore was shipped to smelters, and a concentrating plant was erected, but the mines are not being worked at present. The Nevada property is in the Ely district and lies immediately to the west of the Nevada Consolidated. The ore deposit is extensive, but production has not yet commenced, owing to various difficulties. At the end of 1908, a controlling interest was purchased by the Cole-Ryan group, and since that time operations have been confined to re-organizing the mine and the plant. Shafts have been re-timbered, a new shaft sunk, development work done at various points, and prospecting done by churn-drill. Additional claims have also been purchased and the control of the Butte & Ely company has been acquired. The report of the company for the 11 months to December 31, 1909, gives an outline of the re-organization work done under the management of F. P. Mills. During this period, $117,340 has been spent on mining work, $43,880 on drilling, and $122,905 on plant, surface equipment, etc. The cost of purchasing the control of the Butte & Ely was $239,465, and the amount spent in buying and testing the additional claims was $231,565. There were other small items of expenditure, which brought the total for the 11 months to $911,897. The company had $424,859 cash in hand at the beginning of the period, and raised additional funds by the sale of bonds amounting to $1,072,000. At the end of the year the cash in hand was $592,848.

St. Austell China-Clay Works.—This company has been formed for the purpose of acquiring the Forest and Trembear china-clay pits, a mile to the northwest of St. Austell, Cornwall, and of extending the operations and providing additional plant. The leases were obtained in 1908 from the Sawle estate by Messrs. Wedlake, Hooper, and Dingle, of St. Austell, who developed the properties and erected a furnace and treatment plant. A London promoting firm is undertaking the subscription of the additional funds now required. The capital of the company is £40,000, of which 26,748 shares of £1 are offered to the public, and 10,000 have been underwritten. The price paid to the promoters is £12,500 in shares and £6300 in cash. A contract has been made with the International China-Clay company of Paris, for the purchase of the whole output of the pits for a period of ten years. The reports on the properties accompanying the prospectus were made by Thomas Grose of St. Austell, and by W. Marshall Grose, managing director of the Paris company.

Rhodesia Gold Mining & Investment.—This company has been formed by the Lewis & Marks group to undertake exploration and development work in Rhodesia and to provide financial assistance for such operations. W. T. Pauling is general manager with his headquarters at Bulawayo, and C. B. Kingston of Pearse, Kingston, & Browne is consulting engineer. The company has acquired a number of mining properties, notably the Lonely Reef and the Sabi, and has formed subsidiary companies to work them. The Lonely Reef mine is in the Bembesi district and is situated 56 miles north of Bulawayo. The report of Leopold Weill shows that the mine contains gold ore consisting of a quartz vein in chloritic schist. The workings are down 300 ft., at which level the profitable ore has been developed over a length of 1000 ft., with an average thickness of 2¾ ft. and a content of 1 oz. per ton. The owners from whom the mine was purchased were treating from a 1000 to 1200 tons per month and making a profit of £3000 per month. It is assumed that the profit obtainable by treating the estimated ore reserve is £125,000. Mr. Weill advises that £60,000 shall be spent in developments and in extensions of the stamps and cyanide plant. He also recommends the provision of a slime-plant to treat accumulated as well as current slime. By means of this additional expenditure the profit should be raised to £9000 per month. The Sabi mine is in the Belingwe district Up to the present time 47,700 tons have yielded gold worth £65,580, or 27s. 4d. per ton, the plant consisting of 10 stamps, a wheeler pan, and cyanide plant. The slime has not yet been treated, and has been allowed to accumulate, pending the provision of the necessary plant. For the last few months the mill has been closed and operations have been concentrated on development with the idea of working on a larger scale.

Ashanti Goldfields Territories.—This company has been formed by the Ashanti Goldfields Corporation for the purpose of taking over the tract of undeveloped country belonging to the corporation and conducting exploration work upon it. The corporation's territory consists of 100 square miles and only seven have been developed so far; on these are the successful mines which have lately attracted so much attention. In addition to the remaining 93 miles, the Territories company will acquire a further tract of 25 miles at present owned by other parties. The operations will be conducted by J. N. Justice under the advice and direction of the corporation's consulting engineer, W. R. Feldtmann. The capital of the new company is £300,000 divided into 1,200,000 shares of 5s. each. Of these 400,000 were allotted to the corporation as purchase price, together with £5000 in cash; 10,200 have been subscribed for by the signatories of the memorandum of associations; and 401,800 were offered to the public.

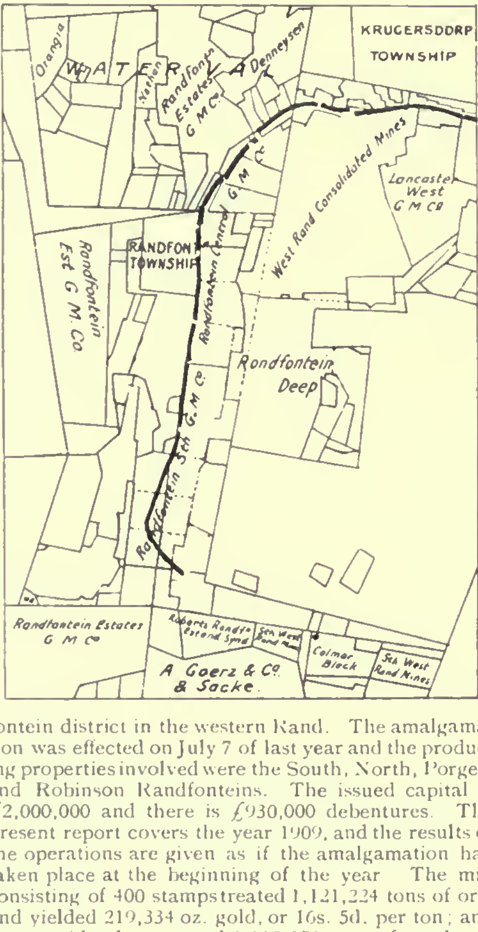
Pongola Gold Mines.—The prospectus of this company offers for sale 60,000 ordinary shares of £1 each out of a capital of £150,000. The promoter is Nicholas White, and the consulting engineer is T. E. Hardy. The property to be acquired is the farm Jammerdal on the banks of the river Pongola, and is situated in the Vryheid district of Natal. It practically adjoins the Wonderfontein mine, which has been developed during the past year by a syndicate representing various Rand houses. The prospectus does not tell much about the ore at Jammerdal, but states that a 10-stamp mill is to be erected.

China-Clay Corporation.—This company has been formed to acquire china-clay lands in the southern part of Dartmoor, Devonshire. The sett is known as the Redlake, and is situated about 8 miles north of Ivybridge station on the Great Western Railway, this side of Plymouth. The vendor is C. E. Cottier, a lawyer at Plymouth, and the promotion of the company is in the hands of the L. Ehrlich & Co., and Coates Sons & Co., which firms have between them underwritten the present issue. The capital of the company is £400,000, divided into 200,000 non-cumulative 6% preference shares of £1 each and 200,000 ordinary shares of £1 each. The preference shares are also entitled to one quarter of the profits after the ordinary shares have received 6%. The prospectus offers 120,000 preference shares, which, as already mentioned, have been underwritten. The vendor takes as purchase price £20,000 in cash and £70,000 in ordinary shares, and £80,000 in ordinary shares is being paid as underwriting commission. The remainder, 80,000 preference shares and 50,000 ordinary shares, is held in reserve. The proposition is to send the clay by a pipe-line down to Bittaford near the railway, where plant for treating it is to be erected. The clay property consists of 1300 acres, of which 98 acres has been prospected by means of 80 trial shafts. The deposit is reported to be irregular, but extends roughly 2500 ft. in length by 600 to 1400 ft. in width. The depth is said to be 50 ft. as far as tested. W. Forster Brown, of Cardiff, and R. Handsford Worth, of Plymouth, have written reports on the property and their views are decidedly optimistic. The flotation will provide £95,000 as working capital. The output, the cost of treatment, and the profit are estimated in the prospectus on this basis, and the gross profit to be obtained by producing 45,000 tons per annum of the best clay and 10,000 tons of 'seconds' is given at £39,375. The purchase price and the underwriting commission together form a large sum to pay for a 30-year lease on a new property.

Sudan Goldfield.—This company was formed in 1904 by John Taylor & Sons for the purpose of acquiring various mining and prospecting rights in the Sudan. Operations have been concentrated on the exploration and development of the Om Nabardi mine, which had been operated in days gone-by. The gold deposit, though extensive, is irregular in content and has not proved profitable. In December 1908 the company was reconstructed with the object of raising a further supply of working capital. The report now published covers the period from the reconstruction to the end of December 1909. From this it appears that the capital issued consists of 127,939 shares of 10s. each, upon which 6s. per share was credited as paid, and 3s. paid up by shareholders in cash. During the period covered by the report 11,846 tons of ore were treated in the stamp-mill and yielded 5679 oz. of bullion, which realized £20,465. There is an accumulation of slime and tailing amounting to 13,000 tons averaging 2⅓ dwt. and the directors are considering the advisability of erecting a cyanide plant to treat it. The expenses at the mine and in London were £34,733, so that the adverse balance on the year's work was approximately £14,250. The development work has been pushed energetically at various points. The veins are narrow, averaging from 9 in. to 2 ft., and the content of their better parts varies from 8 dwt. to over 2 oz. per ton. On December 31 the actual amount of profitable ore was estimated at 8200 tons, in addition to 2900 tons of patchy ore of doubtful value. The mine is equipped with a 10-stamp mill and is connected with the Government railway by a branch line. Labour is plentiful and satisfactory, and ample supplies of water are obtained from wells. The workings extend over half a mile and at two points are down 480 ft. There are four distinct old workings, none of which went down more than 120 ft. Though the present results are none too good, there are indications that encourage further development. Operations will be actively continued. The first superintendent was Nicholas Holman, and recently D. Gill-Jenkins has been in charge.

Memba Minerals.—This company has been formed, with Hans Sauer as chairman, to acquire the mineral rights over 20,000 square miles on the coast of Portuguese East Africa bounded by the Lurio river on the north and west and by the Quilimane district on the south. The pioneer explorer is Max Schoeps, who becomes a director both of the company and of the operations on the spot. According to this gentleman the prospects are wonderful. For instance, he says that there is scarcely a stream where gold cannot be profitably obtained. He also vouches for a gravel deposit 2 miles long and from 6 to 8 ft. deep containing on the average no less than 1¾ oz. per ton. He speaks of "bartering from the natives small nugget-like specimens of gold of a sharp angular character with small bits of decomposed oxidized quartz still clinging to them." From this it appears that the business of the company is an untechnical pioneer venture rather than a precise mining and exploration proposition. No prospectus is issued, though advertisements in the nature of one have appeared in the Press. The capital is £150,000, of which £105,000 in shares has been paid to the vendors of the concession and £20,000 has been subscribed in cash for working capital.

Randfontein South.—This company belongs to the Robinson group and is the consolidation of a number of producing mines and other property in the Randfontein district in the western Rand. The amalgamation was effected on July 7 of last year and the producing properties involved were the South, North, Porges, and Robinson Randfonteins. The issued capital is £2,000,000 and there is £930,000 debentures. The present report covers the year 1909, and the results of the operations are given as if the amalgamation had taken place at the beginning of the year. The mill consisting of 400 stamps treated 1,121,224 tons of ore, and yielded 219,334 oz. gold, or 16s. 5d. per ton; and the cyanide plant treated 1,119,073 tons of sand and slime and produced 153,203 oz., or 15s. 5d. per ton. The total production was 372,537 oz., and the income of the company was £1,564,136, or 27s. 10d. per ton. The total working cost was £1,045,094, or 18s. 7d. per ton, leaving a profit of £519,041 or 9s. 3d. per ton. The cost is 1s. 11d. lower than in 1908 and the profit was £100,535 greater. That the cost is gradually being reduced is seen from the fact that during the last three months the average was 18s. 2d. per ton, and there is every expectation of a continued decrease. On December 31, the reserve of developed ore was 2,683,233 tons averaging 7·8 dwt. over a milling width of 30 in. Of the above-mentioned profit, £261,941 was earned after the amalgamation was effected, and out of this amount £200,000 has been distributed as dividend at the rate of 10%. The joint managers for the company are C. A. Ferguson and C. Baring Horwood.



Randfontein Central. This company was formed three years ago to acquire and develop an extensive tract of auriferous ground in the Randfontein district, belonging to the Robinson group and adjoining the producing properties incorporated in the Randfontein South. The time has so far been occupied in thoroughly developing the deposits and in erecting a treatment plant on an unusually large scale. The report for the year 1909 shows that the property extends for 3½ miles along the strike of the 'reef' and is being developed by means of five permanent main shafts and five temporary shafts. The ore on coming to the surface will be drawn by locomotives to a central sorting and breaking station, from which it will be delivered by belts to the stamps. The amount of ore developed on December 31 was 2,156,980 tons, of which 1,832,923 tons average 7·7 dwt. over a milling width of 30 in. There are also reserves of profitable ore at the surface raised in development, and also on the East reef. The metallurgical plant comprises 600 stamps each weighing 1650 lb., together with 9 tube-mills, 12 collecting-tanks and 24 treatment-tanks for sand each 60 ft. diam., and 6 collecting and 17 treatment-tanks for the slime each 70 ft. diam. It is reported that milling operations should commence toward the end of 1910. A. D. Bacon is manager, and David Gilmour is the consulting mechanical engineer in charge of the design and erection of the plant.

Rio Tinto.—The report for 1909 of the leading copper producer in Spain shows that the amount of ore mined during the year was 1,788,987 tons with an average content of 2·349% copper; of this, 604,799 tons was ore suitable for shipment to chemical manufacturers and 1,184,188 tons was for local treatment in the blast-furnace and by leaching. The amount of cupriferous ore shipped during the year was 600,946 tons, in addition to which 619,814 tons of washed ore was shipped for its sulphur value only. The copper production at the mine was 24,364 tons, and the content in the shipped ore was 11,008 tons, making a total output of copper during the year of 35,372 tons. The actual sales appearing in the accounts for the year were 35,496 tons. The income and expenditure are not published, but the gross profit for 1909 was £1,515,623. After deducting £122,999 for taxes, £81,123 for expenses of administration, and allowing £85,269 for depreciation, and bringing forward the undistributed balance from last year, a sum of £1,233,995 remains. Out of this £81,250 has been distributed as dividend on the 5% preference shares and £1,125,000 as dividend on the ordinary shares, at the rate of 60%. The par value of the ordinary shares is £5 and on the day when this report was issued they stood at £76 in the market, which means that investors are at present content with 4%. The expensive work in connection with the removal of the overburden from the western portion of the San Dionisio orebody has been advanced actively during the year and the amount excavated has been over one million cubic metres. During the current year the top of the orebody should be reached and mining by open-cut commenced. In addition 1,200,000 cubic metres of overburden has been removed from the South lode, and much more work has to be done here before the normal output is once more reached These operations for open-cast work and the necessary equipment therefor have entailed considerable expenditure and £300,000 has been allocated for the purpose during 1909. The sums employed in this way are charged to a suspense account which will be liquidated when the ore is mined. The funds required in the meantime are provided out of the reserve fund. The water-supply has given no trouble and the reservoirs, including the one recently built, are now full.

Maikop Midland Oilfields.—This is a subsidiary of the Anglo-Maikop Corporation and is formed for the purpose of acquiring properties in the Maikop district. This district is situated in the western part of the Caucasus about 50 miles from the port of Tuapse on the Black Sea, and is at the opposite end of the Caucasus to Baku, which is on the Caspian Sea. Maikop suddenly sprung into fame by the discovery of a gusher in September last. Sir Boverton Redwood and A.W. Eastlake have reported favourably on the properties acquired by the Maikop Midland, and will act as technical advisers to the company. The capital is £157,500 divided into 150,000 ordinary shares of £1 each and 150,000 deferred shares of 1s. each. Of these shares, 100,000 ordinary and 20,000 of the deferred are offered for public subscription, the remainder going to the Russian owners together with £20,750 in cash, and to the Anglo-Maikop Corporation, which has guaranteed the success of the present issue.

Maikop Oil Proprietary.—This company has been formed to acquire oil-land in the newly discovered Maikop district in the western Caucasus. Paul Dvorkowitz, well known in connection with the Russian oil industry, is managing director and technical adviser. The capital is £252,500 divided into 250,000 ordinary shares of £1 and 50,000 deferred shares of 1s. each. Of these 125,000 ordinary and 12,500 deferred are offered for public subscription. The whole issue is underwritten by the promoters, the United Investment Corporation.

International Maikop. — This is another company formed to operate in the newly discovered Maikop oil district in the Caucasus and 50 miles from the Black Sea. The properties were selected by the representative of J. S. Bergheim, one of the board, and the prospective managing director. Mr. Bergheim is chairman of the Nigeria Bitumen Corporation. The capital of International Maikop is £83,000, divided into 320,000 ordinary shares of 5s. each and 60,000 deferred shares of 1s. each, of which 160,000 of the former are offered for public subscription. The issue has been underwritten.

Maikop Premier Oil Syndicate.—This syndicate has been formed to acquire properties in the newly discovered Maikop oil district in the Caucasus. Thompson & Hunter are the engineers, and the commercial part of the business is in the hands of Matheson & Co. Arthur C. Claudet is one of the directors. The syndicate has a working capital of £19,000.

Oran Oil.—This company has been formed for the purpose of acquiring petroleum land and works in Algeria belonging to the French company 'Societe Anonyme des Mines de Petrole d'Ain-Zeft.' This property is about 70 miles east of Oran and 15 miles from the Mediterranean coast, and is on the line of railway connecting Oran and Algiers. It has been worked so far in only a small way. There are eight wells but only two are being pumped at present. A refinery has been built with a capacity not greater than 500 barrels of crude oil per month. Sir Boverton Redwood, William Topley, and J.S. Stephan are all of opinion that with additional capital the output could be greatly increased and a profitable business established. The object of the present flotation is to raise the funds required. The capital of the new company is £175,000, of which £55,000 in shares is allotted to the promoter together with £30,000 in cash, while 120,000 shares are being offered for public subscription. The promoters pay £48,000 in shares and £24,000 in cash to the French vendor company, and they guarantee the subscription of 80,000 of the shares offered to the public.

Langlaagte Estate & Gold Mining.—This company belongs to the Robinson group of mines and is situated on the outcrop near the centre of the Rand. The manager is J. A. Hebbard. Dividends have been paid regularly since 1889, the total distribution to the end of 1909 having been £2,152,305. The mine is now in much poorer ground than formerly, and for ten years has not occupied the important position among gold producers that it did say in 1895. In September last the prevalent policy of consolidation was adopted and Block B and Langlaagte Exploration were absorbed, the issued capital being at the same time extended from £470,000 to £869,500. The report for 1909 shows that 599,216 tons of ore was treated in the 200-stamp mill, producing by amalgamation 119,695 oz. After regrinding in 5 tube-mills, 382,935 tons of sand was cyanided yielding 48,732 oz., and 229,153 tons of slime also yielded 18,467 oz. The total yield was therefore 186,894 oz. or 6·238 dwt per ton milled. The income from the sale of gold was £784,512 and the total cost £483,195, leaving a profit of £303,874, or 10s. 1¾d. per ton. The Langlaagte battery has been treating Block B ore for some time, and the profits due to Block B before and after the amalgamation of the companies have been segregated in the accounts. The amount due to Block B for profits prior to amalgamation was £72,469, so that the actual profit of Langlaagte Estate for 1909 was £231,404. Out of this, £177,425 has been distributed as dividend and £78,597 has been spent in purchasing property and other capital expenditure. The reserve of developed ore on December 31 was 1,287,268 tons, sufficient to supply the mill for two years, and current development keeps pace with the depletion. The expanded company promises to have a life of many years, and there is every expectation of the cost being further reduced.

North Broken Hill.—This company pursues its prosperous way and the report for the second half of 1909 shows an increased profit in spite of the depression in the prices of lead and silver, the figures being £33,899 as compared with £31,206 during the previous six months. Out of the half-year's profit £17,549 has been written off the expenditure on plant and on shaft-sinking, and £14,000 has been distributed as dividend which is at the rate of 20% per annum. At the end of September the old concentrating mill was closed and two units of the new mill placed in commission. The efficiency of the new plant has been gradually increased until it now handles 4000 tons of ore per week. A third unit will be completed in the course of a month or so. During the six months 87,049 tons of ore was concentrated, assaying 16% lead, 14·2% zinc, and 6·7 oz. silver; and the lead concentrate produced was 14,770 tons, assaying 70·58% lead, 6·79% zinc, and 20·29 oz. silver. The recovery was 74·69% lead and 52·86% of the silver contained in the ore. The other products of concentration were: 43,011 tons of zinc tailing assaying 18·8% zinc, 4·1% lead, and 3·6 oz. silver; 9035 tons of slime assaying 12·9% lead, 15·7% zinc, and 8·2 oz. silver; and 20,233 tons of waste tailing assaying 3·3% lead, 9·3% zinc, and 3·6 oz. silver. The whole of the zinc tailing was delivered to the

Amalgamated Zinc (De Bavay's) company. The exploration of the mine continues to open up and indicate the presence of large ore-bodies The reserve above the 950 ft. level, that is the part of the mine from which ore is now being drawn, is estimated at just over one million tons. The shaft has been sunk to 1100 ft. and diamond drilling has indicated the continuance of the ore to that level, the estimated additional reserve being 660,000 tons. It is intended to continue the sinking of the shaft to 1300 ft. The working costs during the half-year have been as follows: Mining £40,547, milling £13,202, development £7785, general office expenses and directors' fees £2166, and income-tax £950 The cost at the mine averaged 13s. 10d. per ton of ore mined, or £4 2s. 5d. per ton of lead concentrate produced; this figure compares with 15s. 1¾d. per ton of ore during the previous half-year. At the same time the amount of ore treated increased from 66,797 tons to 87,049 tons. The whole of the lead and zinc concentrates are sold for several years in advance.

Broken Hill South Silver.—The output of this mine during the second half of 1909 was the largest on record, being 167,002 tons of ore as compared with 137,848 tons during the previous half-year, which itself was an improvement on any period during the life of the mine. The reason for this expansion is the excellent development of the orebodies and the provision of a new concentrating mill which came into operation at the beginning of 1909. The full benefit of the improved plant was not reaped at once, for, owing to difficulty in securing satisfactory contracts for the sale of the lead concentrate, the mill did not work at full capacity during the early months of 1909. The report for the second half of the year shows that the concentrate is now being readily sold and that in consequence the output has been increased. The average content of the 167,022 tons raised and milled was 14.6% lead, 12.3% zinc, and 5.8 oz. silver. From this were produced the following: 24,531 tons of lead concentrate assaying 72.7% lead, 20.7 oz. silver, and 5% zinc, and containing 73% of the lead and 52% of the silver in the ore; 69,095 tons of zinc tailing assaying 17.9% zinc, 4.2% lead, and 3.4 oz. silver; 22,854 tons of slime assaying 11.1% lead, 10.8% zinc, and 5.8 oz. silver; together with 50,785 tons of waste tailing assaying 2.4% lead, 9% zinc, and 1.9 oz. silver. It is a notable feature of the half-year's work that the extraction of zinc has been substantailly increased, that is to say the proportion of zinc in the zinc tailing has increased and that in the waste decreased. The zinc recovered in the zinc tailing has been 60% of the total amount contained in the ore, as compared with 47% during the previous half-year. As regards the zinc tailing 6440 tons was delivered to the De Bavay company during the half-year. On the completion of the new plant of the De Bavay company at the end of February the deliveries will be increased to about 3000 tons weekly. The Broken Hill South Silver Mining company has on hand 1,078,743 tons of tailing from the old mill, under contract of sale to the Zinc Corporation, and 137,257 tons from the new mill, sold to the De Bavay company. In addition there is 198,652 tons of slime awaiting a satisfactory process for treatment.

The mine is yielding well in the two lowest levels, at 825 ft. and 970 ft. The new main shaft is down to 1100 ft. and the development of another level at this depth has been commenced. In the 970 ft. level it has been necessary to use a more efficient system of timbering and also to fill the old stopes with refuse, and the cost of operations has accordingly increased slightly over the two previous half-years. Mining and development have cost 11s. 3d. per ton as compared with 10s. in the previous half-year; but concentration is now cheaper being 3s. 8d. as compared with 3s. 11d. The total working cost is now 14s. 11d. per ton as compared with 13s. 11d. during the previous half-year These figures are however much lower than two or three years ago when the cost was over 20s The income from the sale of products during the half-year was £193,480 and the working expenditure £141,392, leaving a profit of £52,088. Office expenses, taxes, etc., absorbed about £4000, and £40,000 was distributed as dividend, being at the a te of 40% per annum on the nominal capital.

Salt Union. This company is by far the largest producer of salt in England. It owns extensive tracts of salt land in Cheshire and is managed at Liverpool. It was formed as an amalgamation of many owners in 1889 at a period when German and American production threatened competition not only in the chemical trade but in the export trade to foreign countries for domestic uses. During the first year of its existence the production of salt was approximately 1,650,000 tons and the net profit was £320,400, out of which debenture interest, 7% on the preference shares, and 10% on the ordinary shares was paid, besides £40,000 being placed to reserve. How the production and profits dropped subsequently may be seen by the gradual fall in the ordinary and preference dividend. The ordinary dividend dropped to 1% in 1896, since which time the only distribution in this class of share was 1¼% in 1907. The preference shares received their full 7% until 1896, but since then 13 years have provided only 35½%. With regard to the capitalization of the company, it must be remembered that some years ago an effort was made to bring it more into line with the decreased value of the business. Originally there were 200,000 ordinary shares of £10 each and 100,000 preference shares of similar denomination, as well as £1,200,000 in 4½%

debentures. The preference were cut down to £6 each and the ordinary to £4 each, and the rate of distribution of late years on the preference shares has been on the reduced capital. The report for the year 1909 shows a production of 774,000 tons as compared with 781,000 in 1908. The net profit was £100,438, out of which £54,000 was paid as debenture interest, £25,000 as a dividend at the rate of 4⅛% on the preference shares, and £20,000 placed to reserve. It is stated that there has been a further shrinkage in the amount bought by chemical manufacturers, and that the bad fishing season has caused a decrease of the demand from this source. Also competition in the Indian markets has tended to reduce the export price. In order to keep up to date, the company is erecting modern plant at Weston Point on the Manchester Ship Canal, near the present works, the money being provided by the recent sale of surplus lands. This plant will be of the multiple-vacuum type and it will be operated electrically. Improvements have also been introduced into the system of purifying the brine, for the purpose of producing a better quality of salt that will command a higher price. But with the present economics of the world's industry in salt, it cannot be expected that even the best business management and the most modern technical skill can place the Salt Union again in the position it occupied in 1889.

Quincy.—This copper mine is situated at Hancock, Michigan, in the centre of the Lake Superior district, and a few miles southwest of the Calumet and Hecla. Operations commenced as long ago as 1848, and dividends have been paid regularly since 1862. Until about ten years ago the development was done in what may be called the old-fashioned way. The shafts or inclines had not been sunk with precision and the hauling eventually became difficult. Seeing that the workings were down more than 3000 ft. vertical the conditions of mining were such that the mine must be either closed or else the system of operation entirely re-organized. The owners decided on the latter course and much money has been spent of late years not only in sinking new inclines, straightening old workings, and providing new plant, but additional property has also been bought, including the Pewabic and Franklin mines. At the present time the Quincy is a type of a modern mine ; the developments are well ahead of production, and the hauling and dressing plants contain every possible improvement. As is well known, the copper in this district occurs native in an amygdaloid melaphyre. The ore is crushed by steam-stamps and jigged, yielding a concentrate, or as it is locally called, 'mineral,' which contains on an average 40% of metal. The lode has a dip of about 55° at the surface and gradually flattens in depth. At the bottom workings, which are more than a mile deep, or over 4000 ft. vertical, the lode has a dip of 37°. A year or two ago trouble was experienced through a fall of rock in one of the shafts, and since then the shafts have been thoroughly timbered wherever required. The amount of ore raised is over 4000 tons per day, and the content of copper slightly over 15 lb. per ton.

The report now issued covers the year 1909 and it shows that the output still continues to grow. The amount of concentrate smelted was 17,512 short tons and the yield was 11,256 tons of copper. The income from the sale of the copper was $3,034,810 ; the cost of mining was $1,765,965 ; of development, $216,130 ; of smelting, $206,461 ; of construction work and shaft-sinking, $111,409. Other small items appear in the account, and the net profit for the year was $688,850, out of which $495,000 was paid as dividend on the issued capital $2,750,000, and $120,000 was paid as the final instalment of the purchase price of an adjoining property. The report gives details of the various improvements in the methods of mining, development, and treatment, and shows that the cost of production has been reduced by ¾c. during the year as compared with 1908, while at the same time the production increased by 9%. The developments show that the reserve of ore is well ahead of the mill, and both in depth and also owing to the increased areas lately purchased, the company has a long life before it. The credit of the excellent results now obtained is due largely to the general manager, Charles L. Lawton.

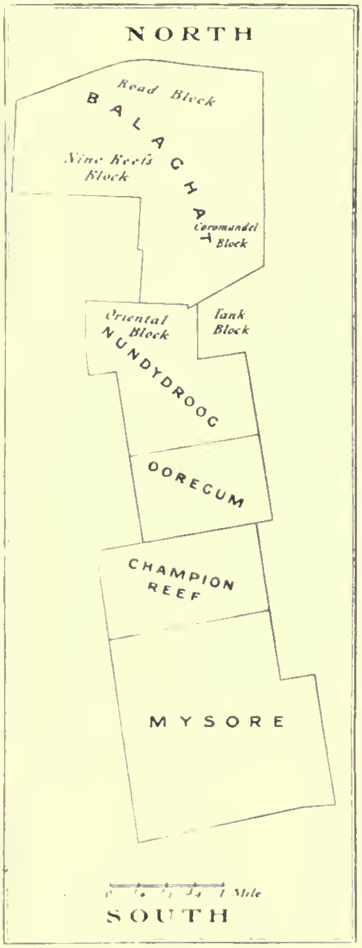
Australian Oil Company.—This company has been formed for the purpose of acquiring oil-shale lands at Capertee and Murrurundi in New South Wales, the position of the two districts being shown on the accompanying map. The promotion of the company is in strong hands, and the directorate includes the names of Robertson Lawson, the accountant, J. E. Champney, a director of the Cape Copper Co., and Lord St. Oswald, a coal proprietor in Yorkshire. The properties have been examined by Ronald Johnstone & Son, of Glasgow, a firm of wide experience in shale mining. R. R. Tatlock & Thomson, the analytical chemists, also of Glasgow, have reported on the oil and other products obtained by distilling the shale. A bulk-sample of 85 tons was shipped from Murrurundi to Scotland, where it was tested in retorts of the type employed in the Scottish oil-shale distilling works Ronald Johnstone & Son report that the Murrurundi property has been prospected by drifts and the presence of a profitable seam has been demonstrated along 1½ miles of outcrop. The proved shale is over a million tons and the probable further resources are another 1½ million tons. The cost of mining and delivering to the site of the refinery works, three miles away at Temple Court railway station, is estimated at 8s. per ton. This station is on the main line of the Northern railway connecting Newcastle with Brisbane, and is 115 miles from the former. The policy is to erect retorts at Murrurundi and to forward the crude oil thus obtained to Newcastle to be refined. The capacity of the retorts and refinery will be 3 million gallons of crude oil per annum, and the cost of providing this plant is estimated at £135,000. The shale is evidently of high grade, some of it containing as much as 112 gal. crude oil per ton. The sample sent to Scotland for trial yielded about 70 gal. per ton together with 24 lb. sulphate of ammonia On fractionating this oil the products were 5½% naphtha, 25% illuminating oil, 25% lubricating oil, 6% crude wax, and other smaller intermediate products The richest portions of the shale are valuable for the purpose of enriching gas and there is a demand for it for export. It is intended therefore during the construction of the treatment-plant to mine and sell some of this and obtain a profit from the beginning of operations. The properties at Capertee are not at present of the same importance as the Murrurundi. One of them, the Genowlan, used to belong to the Australian Kerosene Oil Co., which some years ago used to mine and export the richer portions but did not erect plant for producing oil. The other adjoining properties contain large deposits of shale, but the exploitation of this district will not be undertaken until the Murrurundi property has been developed and the output placed on a commercial basis. The capital of the company is £300,000, and the purchase price is £130,000, payable as to £96,000 in shares and £34,000 in cash. The prospectus offers 204,000 shares for subscription ; out of the proceeds £34,000 will form the cash payment to the vendor and £170,000 will be devoted to working capital. The issue is underwritten.

Commonwealth Oil Corporation.—This company was formed in December 1905 to acquire oil-shale lands in the Capertee and Wolgan valleys in the Blue Mountains, 120 miles to the northwest of Sydney, New South Wales. The promotion was in the hands of people whose names are well known in the newspaper world, such as Newnes and Harmsworth. The report was made by D. A. Sutherland, who has since continued as consulting engineer and general manager. In 1906 the company acquired by purchase the property of the New South Wales Shale & Oil Co., including shale land at Torbane and a refinery at Hartley Vale, both within 30 miles of the corporation's own property. The New South Wales company was the only producer of oil in the State, and at the present time there is no other producer though as will be seen by referring to another paragraph on this page a rival will be in the field before long. The capital of the corporation was £800,000, of which £725,000 has been issued, and there was also £150,000 of debentures. Development of the properties proceeded slowly and the position of the corporation became far from satisfactory, although it seemed certain that the properties afforded a sound investment. A change was made in the directorate and Sir John Brunner was appointed chairman. At the same time a further issue was made of £265,540 in 6% convertible debentures for the purpose of providing the additional working capital required. The report now issued brings the history of the corporation down to September 30, and further details and opinions were given by the directors, two of whom have just returned from a visit to the properties, at the meeting of shareholders held in the middle of March. Progress continues to be slow, having been impeded greatly by the labour troubles and coal strike, but the directors are strong in their belief that the corporation will soon make substantial profits.

As already mentioned, the properties are in the Capertee and Wolgan valleys. The shale is in the form of a horizontal bed and extends under the hills separating the two valleys. The total area of the property is about 35 square miles, of which about one third is known to contain oil-bearing shale. The thickness of the deposit as far as explored on the Capertee side is 40 in. on an average; and on the Wolgan side, 24 in. About 60 ft. below the shale a coal seam has been discovered. So far its extent has been proved over 320 acres and the average thickness is 6½ ft. The upper 3 ft. is of high quality, but the value of the lower portion is depreciated by thin bands of stone. The policy of the company at the present time is to develop the coal before the shale, and coke-ovens of sufficient capacity to produce 1000 tons per week are being erected. Experience in connection with the best method of treating the shale is being obtained at the old works at Hartley Vale. It is expected that the construction of the refinery at Wolgan will be commenced within a few months.

Juga Tin and Power. This is another new company formed to work tin gravel in Nigeria. It has been promoted by the Champion Gold Reefs of West Africa, and the whole of the capital has been guaranteed. Consequently no prospectus is issued, though advertisements have been inserted in the Press "for public information only." The capital is £275,000, of which £60,000 will be in cash and available for working expenses. The tract acquired consists of 13 square miles in the Bauchi district, and includes the Juga and the Sub Juga properties. Of these the former covers 2½ miles and the latter 10½ miles. C. G. Lush reports that on the Juga property 200 acres has been proved to average 4s. per cu. yd. to a depth of 3 yards, at the present price of tin. On the Sub Juga property 500 acres has been proved to contain tin to the value of 2s. 6d. per cu. yd. The company also acquires water rights, which will provide an adequate supply for washing and for generating electric power.

Mysore.—The thirtieth annual report of the premier gold mine of India, covering the year 1909, shows that the prospects are as bright as at any time in its history. On general principles a mine of this age cannot be supposed to have a long life before it, but it must be re-



The Kolar Mines.

membered that an estimate of the prospective life of a mine is not necessarily influenced by the amount of ore already extracted, but is measured by the possibility of finding more ore and extracting it at a profit. Twenty-eight years ago the indications were so discouraging that many shareholders advised a cessation of operations, and the shares were practically valueless. The Mysore will always be quoted as an example of the advantages of perseverance in mining. Since the commencement of production in 1884 the total output of gold has been £11,680,522, and the dividends distributed have amounted to £5,935,094. At the present time the ore reserve amounts to over a million tons, an increase of 30,000 tons during the year, and the vein is maintaining its width and value in the deepest workings, one of which is down 3900 ft. on the dip, another 4200 ft., or about 2700 ft. vertical. Consequently in spite of the age of the mine and the depth of the workings, the outlook is uncommonly good.

During the year the 210 stamps have been in full operation and have crushed 234,500 tons of ore, yielding, by amalgamation, 202,359 oz. bullion. The cyanide plant treated 190,288 tons of tailing and produced 25,890 oz. bullion. The total value of the gold was £894,834. After paying royalty and adding other small receipts, the total income for the year was £854,959. The expenses at the mine and in London were £390,855, leaving a profit of £464,103. Out of this £350,750 has been distributed in dividends, being at the rate of 115% on the nominal capital. In addition £20,000 was placed as the nucleus of a reserve fund, £25,230 was allocated for income tax, £50,000 was allowed for expenditure on capital account and for depreciation, and £19,950 was spent on exploration in the Dharwar goldfield. The new shaft known as Edgar's is down 2600 ft. vertical and the equipment is nearly complete. Connection has been made between this shaft and the workings in the main part of the mine at the 3226 ft. level, and the ventilation of the mine has been greatly improved. The output of gold for 1909 was the highest on record; but the rate of dividend was rather less than during the years 1898 to 1907. This is due, not to an increase in cost, as might be supposed by a casual observer, but to the fact that until two years ago extensions of plant and additional shaft-sinking were paid for out of capital issued for the purpose. The actual profit to the shareholder is greater now than formerly.

Nundydroog.—The report of this company for the year 1909 is the best yet published. The mine belongs to John Taylor & Sons' group in the Kolar district, Mysore, and operations were started in 1882. In 1887 production became active, and dividends were first paid in 1888; since then the profits have gradually increased, though there were trifling waves of depression in 1893 and 1898. During 1909, the amount of ore crushed was 90,100 tons, yielding 78,661 oz. bullion, and 84,240 tons of tailing gave 7945 oz., the total value of the gold won being £346,470. The profit was £163,238, out of which £113,200 has been distributed as dividend, being at the rate of 40%; £23,000 has been written off, and £20,000 placed to reserve fund. It may be pointed out here that two or three years ago the company adopted the new policy of charging all expenses against revenue, instead of paying bigger dividends and simultaneously offering new shares to provide for what is called capital expenditure. The formation of a reserve fund is in continuation of this altered policy, and will put the company in a strong position. The mine continues to develop satisfactorily and the reserve on December 31 was 126,244 tons, a slight increase during the year. In January 1909, operations were greatly impeded by a fire in one of the shafts. Considering this drawback, the excellence of the year's results is even more noteworthy. It is interesting to note that since the commencement of operations the mine has yielded gold to the value of £3,645,989, and distributed £1,540,535 in dividends. The company has acquired additional land between its mine and the property known as the Oriental block, which latter was acquired in 1904. By obtaining this extra piece of ground, it will be possible to gain access underground to the Oriental block and so development will be facilitated. The company a year or two ago became interested in the Anantapur goldfield and last year took an option on the South Jibutil block. Exploratory work this year has yielded promising results and there is every prospect that the option will be exercised. The only note of regret in the report is in connection with the approaching retirement of Thomas Richards, the superintendent. He has held the position continuously for 15½ years, and, in addition to the work connected with the mine, has on many occasions acted in an advisory capacity in other mining matters for the firm. He will be succeeded by his son, Charles H. Richards, who was for some years at the mine before becoming superintendent of the adjoining Balaghat. It is only recently that Isaac Richards, father of Thomas Richards, died at a ripe age after an active life in many responsible positions connected with mining. In this case ability for mining management has proved to be hereditary.

Natomas Consolidated of California.—Five million dollars worth of 6% first mortgage 20-year gold bonds in this company are offered for subscription in London, in a prospectus dated March 31. This company is a consolidation of various gold gravel properties on the American river, Sacramento valley, in the Folsom and Natoma districts. Three of these properties are noted producers; namely, the Natoma, Feather River, and Folsom Development companies. The consolidation was effected at the close of 1908. The issued capital of the company is $11,617,300, and $15,000,000 in 6% mortgage bonds is authorized. Of the latter $1,000,000 is being subscribed in America, and $5,000,000 offered here; $6,581,000 is being exchanged for previously existing bonds, and $2,419,000 is held in reserve. The capital now being subscribed will be used for the purpose of building five additional dredges having 13½ cu. ft. buckets. With the capital held in reserve it is intended eventually to develop the water rights with a view of supplying water for irrigation purposes. On behalf of the Hirsch Syndicate, the English underwriters, C. M. Rolker made an examination of the property last year, and his report is issued with the prospectus. The three companies during the first eight months of 1909 produced $1,329,781 of gold at a cost of $459,371; the recovery was 11·64 cents and the cost 3·885 cents per cu. yd. With the new plant the net profit for 1911 is estimated at $1,910,172.

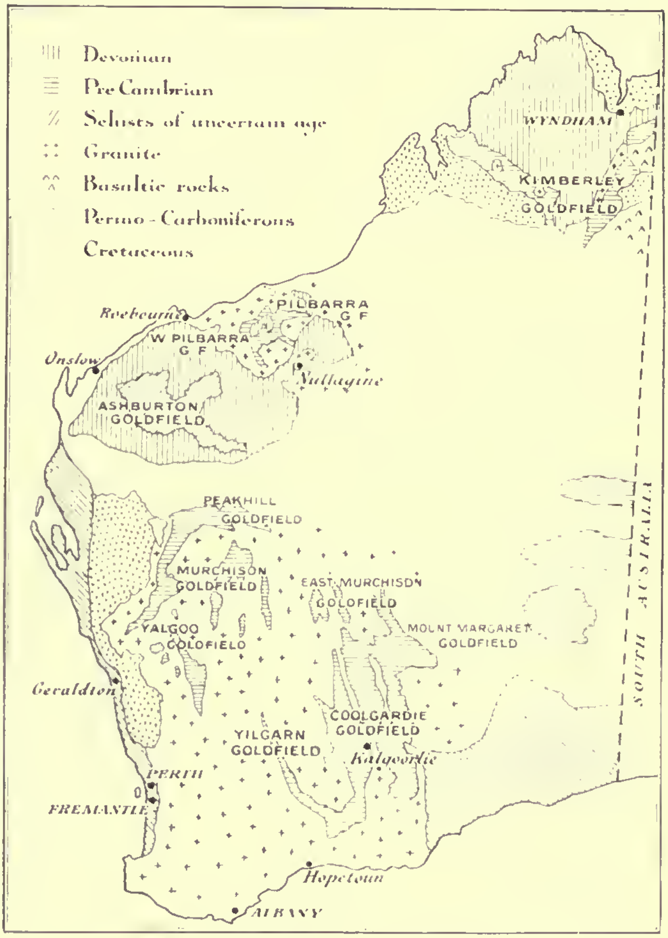
Newfoundland Oilfields.—This company has been formed for the purpose of acquiring and developing oil-bearing land on the northwest coast of Newfoundland near Parsons Pond. The commercial agents for the sale of the products are Meade-King, Robinson & Co., oil merchants, Liverpool, one of the partners of which firm, William Smellie, is a director of the company. Sir Boverton Redwood and J. D. Henry have reported on the property and made suggestions for its development. As far back as 1812, Mr. Parsons, who gave his name to the district, discovered the existence of oil in this locality, and a well was first sunk in 1867 by Mr. Silver, of Halifax. Subsequently in 1895 the Newfoundland Oil Co. commenced drilling and provided some machinery. It is for the object of extending the operations thus begun that the present flotation has been undertaken. Mr. Henry estimates that £40,000 will be sufficient to put in order and equip six of the present wells and to drill six others, besides providing a power-house, a pipe-line, and storage-tanks. The crude oil on refining will give 18% benzine, 38% kerosene, and 41% of heavy oils and paraffin-wax. The capital of the company is £200,000, of which £77,400 in shares and £17,800 in cash is the purchase price, and £12,200 represents commissions and cost of forming the company. The 80,000 shares now offered to the public have been underwritten and 42,600 shares are held in reserve. The present flotation will provide £50,000 as working capital.

PRÉCIS OF TECHNOLOGY

Geology of Western Australia.—The Transactions of the Australasian Institute of Mining Engineers Vol. XIII, 1909, recently to hand, contains an important paper by A. Montgomery entitled : 'Some Geological Considerations affecting Western Australian Ore Deposits.' The geology of this State has not received as wide a study as that of many other mining countries, and geological maps, even in outline, are scarce. We therefore reproduce herewith the map, mentioned by Mr. Montgomery, published in connection with the paper read in 1907 by A. Gibb Maitland before the Australasian Association for the Advancement of Science. The mineral lodes of Western Australia are found in tracts of pre-Cambrian rocks. These consist of both massive and stratified deposits, the former simulating igneous rocks and the latter schistose and highly metamorphosed. Miners call the massive rocks 'diorite,' an incorrect use of the word. It is more suitable to employ the general term 'greenstone.' They have been broken up and invaded by ancient intrusions of granite, which occupies extensive areas throughout the State. This granite contains auriferous veins as well as the greenstone. The strata of greenstone have been much folded and tilted along a northerly strike, and there is evidence to show that they form the base of a great mountain-range running from north to south across the Continent. In addition to these old rocks there are also others of a later date, but still pre-Cambrian. For instance, the Mosquito Creek beds found at Nullagine in the Pilbarra goldfield. These are old metamorphic slates, schists, quartzites, and conglomerates with highly folded strata. There are also the metamorphic sandstones and slates on the west side of the Darling range. It is noteworthy that these Mosquito Creek and other later beds lie unconformably upon the edges of the auriferous greenstone series, and that they are less metamorphic. The theory of the formation is that the old greenstone was first folded and rendered metamorphic, then subjected to extensive denudation, and submerged below the sea; the Mosquito Creek series was deposited during the period of submergence, and subsequently the two series of rocks were submitted to further folding and mountain-building movements. As regards the period of the granite intrusion complete information is lacking, but there is evidence that the flows were not all at the same time. In some places the Mosquito Creek beds are penetrated by the granite, so that at any rate some of the flow was after the formation of these deposits. It seems certain also that the whole of the granite came through in pre-Cambrian times.

The metalliferous deposits are mostly in the greenstone and other metamorphic rocks or in the granite near the contact. This applies not only to the gold, but to the lodes of tin, copper, and iron. Several gold-bearing veins are exploited in the granite but in all cases they are close to greenstone. In the tin districts of Greenbushes, Wodgina, etc., the veins are found at and around the contact of the granite and the schist, and the auriferous copper deposits in the Phillips River district exhibit similar geological conditions.

The greenstone of the pre-Cambrian series frequently shows lamination parallel to the wall of the granite intrusion, and in some places the granite itself exhibits a parallel lamination. This seems to indicate that the granite came in under great pressure and so tends to prove that the rocks now at or near the surface were once at a great depth. It is obvious therefore that the mineral lodes occurring at these points must have been formed at great distances below the original surface; that is, they were of deep-seated origin. They would consequently have been formed, under conditions of high temperature and great pressure, by pneumatolytic rather than by hydrothermal action. The formation of the lodes probably extended over a great period of time, commencing during the folding before the granite intrusion, and even continuing after most of the granite had hardened. In order that the above theory may be finally substantiated it would be desirable to have evidence showing the absence of



Geological Map of Western Australia.

folding and of lodes in the more recent rocks. Mr. Montgomery gives a few examples of Cambrian rocks in the Kimberley region and in the Sterling range that show hardly any folding and that have no metallic veins running through them. These deposits, however, are not on top of the pre-Cambrian greenstone, so that the evidence is not so conclusive as if the younger rock were found on top of the older, if such a case could be found. More definite information is obtainable when we come to consider the Nullagine formations, which are Devonian and are found extensively in the Pilbarra and other goldfields in the Northwest. These deposits consist of beds of conglomerate, slate, and sandstone, and though showing some undulations due to orogenic movements yet preserve their general horizontal position None of the mineral veins come up through these rocks, so it is safe to say that the veins in the pre-Cambrian rocks were formed before the Devonian age.

In continuing the geological history of Western Australia, the author mentions the occurrence of Carboniferous strata in the north and the west, and traces of Jurassic strata along the coast. At the end of this geological period there is evidence that the region was again immersed below the sea.

In discussing the gold-bearing veins, Mr. Montgomery points out that as the veins at present known were formed at least 6000 ft. below the original surface, there is not the same likelihood of their changing in character so quickly in depth, as is customary in ore that has retained its original relative position to the surface; that is, as the deposits now being worked had a deep-seated origin a rapid variation in cómposition need not be expected. This applies naturally only to the contents that were in the veins when formed, for it is possible and also probable that many alterations due to chemical and other agencies have supervened; indeed, seeing that the region was submerged below the sea in comparatively recent geological time, there is good reason to expect changes of this sort. It is to such changes that the author attributes the many characteristic secondary enrichments found in Western Australia. Some of these rich surface-pockets may have been formed by the accumulation of gold derived from the erosion of the surface of the pre-Cambrian rocks. In the Devonian deposits at Nullagine, the conglomerate shows the presence of gold in profitable quantities at some places, and the beds were evidently formed by the erosion of the gold-bearing portions of the older rocks.

The presence of salt in almost all the supplies of water and in the rocks and soils throughout the State is without doubt the cause of many of the characteristics peculiar to the gold deposits of Western Australia. The pyrite and oxides of iron and manganese together with the salt offer every facility for the solution of the gold. Not only has this dissolving action taken place in remote geological ages, but it is actually going on at the present time. One of the occurrences of gold most characteristic of Western Australia is the crystalline mustard gold found clustering round the roots of living trees. Crystals of gold are also found deposited on pyrite and in the form of flakes distributed through limonite. The author discusses at some length the probabilities in connection with the depth to which secondary enrichment may extend.

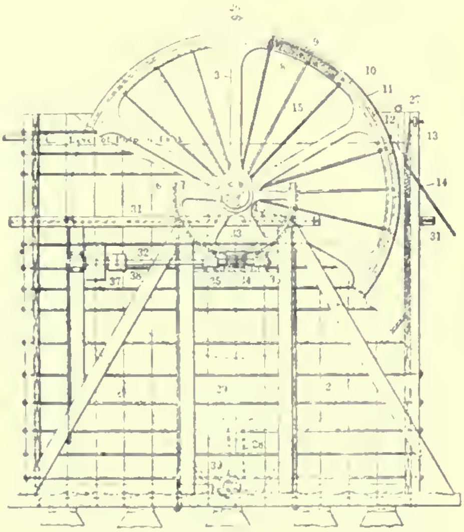
In the discussion that followed the reading of the paper, one of the points receiving attention was Mr. Montgomery's theory as enunciated at the beginning of this abstract that the greenstones were the original rocks that first formed the solid base. Many present at the meeting had always held the theory that the greenstones were eruptives of later date than the granite. The two views were well argued. The data supplied by Mr. Montgomery were, however, fully in support of his view, and for that reason his theory of the history of Western Australia forms a valuable addition to geological science.

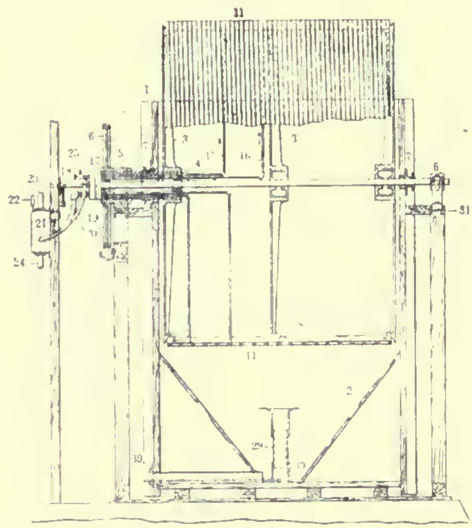
Preservation of Mine Timbers.—John Macoun read a paper at the March meeting of the Canadian Mining Institute on the protection of mine timbers from fungus. There are many forms of fungus that grow on mine timbers, but it is only the fungus of dry rot that causes damage. The mould found on the surface of wet timbers does little or no damage, as it never penetrates into the interior Dry rot is really a misnomer, for its habitat is damp unventilated places. At first the preservation by means of creosote was adopted but this has proved not altogether satisfactory, besides which it entails a cost that is often prohibitive. The author, who is one of the naturalists in the employ of the Canadian Government, noticed that drift-wood on salt-water shores is always better preserved than that on rivers and fresh-water lakes, and that while wood on the fresh-water shores will rot in a year or two that on the sea-shore will remain sound and free from fungus for an indefinite time. The author proceeds to describe experiments made by Henry Aiken for the Canadian Geological Survey. In these experiments various woods were soaked in a hot saturated solution of brine. The wood was free from bark, well seasoned, and thoroughly dry. Timbers treated in this way were used in mines for five or six years and have not yet shown any signs of dry rot. In another experiment two pieces of fir 3½ in. square by 3 ft. long, and weighing 10 lb. each were placed underground in a return air-course; one of them was treated by the salt process and the other not. That which was treated had its weight thereby increased to 12 lb. At the end of 11 months the untreated wood was found to weigh 5 lb. only, while the treated wood had not lost any weight at all. At the end of three years the untreated wood had entirely decayed and the treated wood was as sound as ever. The author therefore strongly recommends that mine timbers should be treated in this way and that timbers already in place should be sprayed with a salt solution.

Wonder Mine.—Much has been heard in London during the last two or three months about the Wonder mine, which is the first gold mine in Natal to be operated at a profit. A descriptive article on the subject appears in the *South African Mining Journal* for January 20, and some account abstracted from this source will be of interest to our readers. The Piet Retief district, in which this mine is situated, belonged to the Transvaal before the war, and consists of the country between Zululand, Swazieland, and the head of the Vaal river. The mine is 45 miles north of Vryheid and is situated on the Pongola river, which flows eastward and then northward toward Delagoa Bay. The gold-bearing deposits were known many years ago, being explored by miners who came southward from Barberton. The Wonder deposit was worked by more than one owner before the war, and though the results were good from a mining point of view, there were local circumstances that militated against success. Eventually, after the war, R. A. Rouillard, one of the staff of the Eckstein group under Sydney Jennings, acquired the property, and with the financial help of several leading men on the Rand developed the property systematically and laid down a plant. Work has so far been on what an engineer connected with the Rand would naturally call a small scale. The plant consists of 5-stamps of 1000 lb. each. Milling started at the end of August last, and during the four months to the end of the year treated 2350 tons yielding gold worth £5356. During this time the cost of working and development was £1782, thus giving a profit of £3698; and it must be mentioned that Mr. Rouillard's syndicate has a capital of only £4700. A small cyanide plant is in course of erection, and in the meantime the tailing is being stored. It is not necessary to use a rock-breaker as the ore is soft enough to be broken by hand by the sorters. The veins at the outcrop have a flat dip and they can be worked by adit. The cars of ore are trammed by an endless cable to the stamps below. The houses of the manager and staff, and the compound of the natives are on the ground higher up. Though the district is hilly it has a bad reputation for malaria, so that it is thought best to live as far out of the valleys as possible. In addition quinine is served out, and so far no fever has visited the camp. Perhaps it is not likely to attack the natives at all, for they have all come from districts where malaria is rife and may be supposed therefore to be indurated.

to a great mine. The average from 80 ft. to 180 ft. along the drift gave only 6 dwt. over 23 in., but it is encouraging that the samples taken at points farthest in show as much as 12 dwt. The ore-supply on No. 1 and No. 2 veins is estimated at 31,316 tons, enough to last four years and the content is taken at 9 dwt. With working costs at 15s. per ton the mine should yield a handsome profit. As long as the mine is operated in the present modest fashion the financial return to shareholders will be eminently satisfactory.

Oliver Filter.—In our issue of January we gave a short account of the Oliver filter, which has been used for over two years at the North Star mine, Grass Valley, California. A further account of this filter, together with working drawings, is given in a paper by G. A. Tweedy and R. L. Beals, read at the meeting of the American Institute of Mining Engineers last month. This paper gave a complete account of the cyanide practice at the Minas del Tajo, at Rosario, in Sinaloa, Mexico, but we extract only that portion relating to the Oliver filter. There are two of these filters here,





THE OLIVER FILTER.

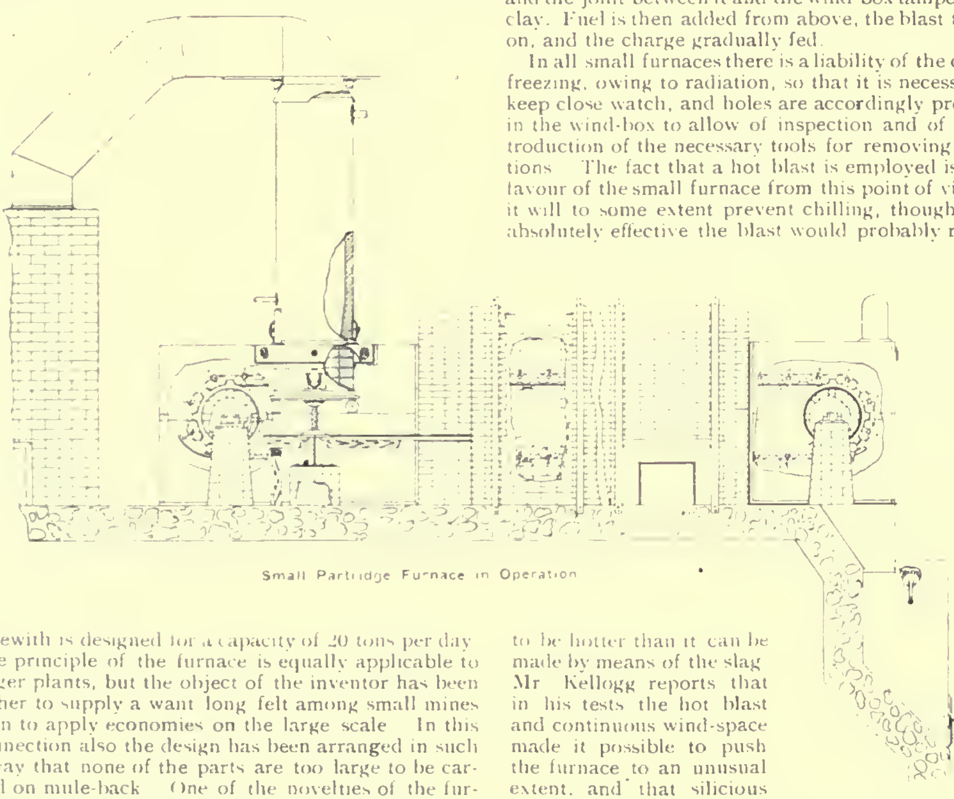
The district is known to geologists as the Ngotshe; the formation belongs to the Archæan system and is similar to that at Barberton. The rocks are mostly crystalline schists, and there are also masses of granite. The Archæan deposits are folded and tilted, so much so as to be vertical in many places. On top of them but unconformably lie the beds of the Karoo system which are practically horizontal. At various places as in the Pongola valley the Karoo beds have been entirely eroded, and the Archæan rocks are found on the surface. The gold-bearing veins consist of quartz, which has been deposited by solutions that have come through the schists. The gold is distributed irregularly and much of it is in visible form. Four veins have been discovered on the Wonder property. No. 1 was worked by previous owners and No. 2 is now being opened up; No. 3 is between the two and though only a foot wide at the surface gave some surprisingly rich ore. A drift on No. 2 is 247 ft. in and the results obtained show that it promises to be more permanent than No. 1, but it cannot be said that the results point

each of a capacity of rather over 60 tons of dry slime per day. Each filter consists of a drum 11 ft. 6 in. diam. and 8 ft. wide, revolving on a horizontal axis and immersed for ⅜ths of the revolution in the slime, which is kept from settling by air-agitation. The outer surface of the drum is divided into sections and is covered with a filter-cloth. The interior is connected with a vacuum during the time the drum is below the level of the slime, and also during most of the time it is above. The cake is formed during submergence. While travelling upward out of the slime, the vacuum dries the cake. On arriving at the top the cake is washed by a spray and the vacuum draws the water through the cake and so removes the precious metal remaining. Just before re-entering the slime, the vacuum is cut off and air under pressure admitted. This loosens the cake and facilitates its removal by the scraper. At the point of re-entry the compressed air is replaced by the vacuum again. The tank (*1*) is made of redwood and has an inclined false bottom (*2*). The drum is made of 3½ in. staves (*8*), which are bolted to the cast-iron spiders (*3*). On the outside of the staves are nailed 24 strips 1 in. thick (*10*), dividing the perimeter into 24 parts. Each of these spaces is provided with a vacuum-pipe (*15*) of $\frac{1}{2}$ in. diam., and also with a compressed-air pipe (*16*). All these pipes are led to the hollow trunnion (*4*). Each section of the perimeter has strips of wood $\frac{1}{2}$ in. square nailed upon it, 1 in. apart, to form channels for the solution. Screens are placed over the strips to support the filtering medium (*9*), which is held in position by the wire binding (*11*). The scraper for removing the cake is shown at (*12*); the spray for the wash water at (*26*); the discharge spray pipe at (*27*); the driving gear at (*6*) and (*33*) to (*38*); and the air-agitator at (*28*). The vacuum and compressed-air pipes, (*15*) and (*16*), fit into two series of 24 holes arranged in circles in a steel plate at the end of the trunnion. In contact with this plate is a stationary plate with a circular groove opposite the ends of the vacuum pipes, but having part of the groove filled up so that one or two of the pipes will be out of connection with the vacuum. At the same time the pipes cut off from the vacuum are connected with the compressed-air supply. The drum revolves in four minutes. The compressed air is supplied at from 5 to 10 lb. and the vacuum is maintained at 25 in. The power required to operate the two filters, pumps, and agitators is 13 hp. The cake formed is from $\frac{3}{16}$ to $\frac{3}{8}$ in. thick, according to the nature of the slime, and when discharged it contains 35% moisture. The filtering medium consists of burlap and duck, and lasts from 3 to 5 months.

Electrolytic Zinc.—In our February issue we published a short note describing Engelhardt & Huth's method of producing zinc electrolytically from a sulphate solution. As the process is in the hands of Siemens & Halske and is in operation in Upper Silesia the additional details supplied to *Metallurgie* and published in the issue of that paper for January 8 will be of interest to our readers. The authors commence by recapitulating the facts concerning the electrolytic deposition of zinc, how it becomes spongy, oxidizes, and tends to re-dissolve if the free acid is strong. There is an advantage in using a strong acid solution, because under these circumstances the deposit is hard and crystalline, instead of spongy, and shows no tendency to re-oxidize. It is the tendency to re-dissolve when the acid is strong that has hitherto prevented the use of strong electrolyte. After many experiments the authors came to the conclusion that this re-dissolving of the zinc can be prevented by making the electrolyte unusually pure. They also found that much of the harmful impurities come from the anode. Accordingly investigations were made with a view of producing a pure anode that would be durable and not too expensive. Platinum was ruled out by its expense, and carbon by its destructibility. Lead, hard or soft, is not suitable, as some of it passes into solution and is re-deposited with the zinc. Eventually lead peroxide was found to be a satisfactory material and the plant is now running on a small scale with anodes made of this material made into the form of rods. The zinc produced is extraordinarily pure being 99·98%. The amount of power required to produce one kilogram of zinc is 3·9 kilowatt-hours. The cost of producing one ton of zinc is given at about £8, including current, wages, materials, general cost, re-melting, and inventors' royalty, but not amortization or cost of the ore. Two-thirds of the cost is that for the current which therefore works out at about one-third of a penny per kilowatt-hour. The inventors consider that consumption of power might be slightly reduced if the peroxide anode could be kept in better mechanical condition. They also quote other electric installations on the continent where current can be obtained at a cheaper rate, though it is probable that anything lower could not be easily obtained in other parts of the world. Another anode that has been tried with success is one made in the form of plates out of manganese peroxide. These have the advantage of being more lasting than those made of lead peroxide. The result of the authors' experience is that this process though successful technically is not widely applicable from a commercial point of view; in fact, it is only because this zinc, being practically pure and in consequence extremely soft, fetches a higher price than ordinary spelter that the electrolytic method can be commercially successful. There is a regular and definite demand on a limited scale for pure zinc of this sort, chiefly from makers of soft brass used in cartridge manufacture. If the production of electrolytic zinc were increased the price would tend to fall to the level of ordinary spelter, so the owners of this process are inclined not to increase their works until such time that power can be obtained substantially cheaper.

Concrete in Metallurgical Plant.—In the *South African Mining Journal* for February 19, some information is given in connection with the use of reinforced concrete in the construction of batteries, cyanide plant, etc., at the new mill of the City Deep mine. The battery is the most forward of all the work, and we have already referred to the use of concrete in the foundations and in the construction of the superimposed king-post structures. The erection of the cyanide and slime plants has more recently been commenced. The settling-tanks for the sand will be of reinforced concrete They will be 50 ft. in diameter and they will be supported on columns 16 in. square and standing 14 ft. 6 in. above the foundations. The main columns for the excavator-track will be 29 ft. high above the foundations; they will stand 18 ft. 6 in. apart and be 18 in. square. Each column is being made in one piece in the shape of a T with the cross-arms measuring 18 ft. along the top. They are built in this shape on the ground and when dry are hoisted into position and tied together so as to form a continuous structure. The inner series of columns for the support of the settling-tanks will be built in place, the dimensions being 16 in. square and 14 ft. 6 in. high. Across the tops of the columns will be placed a series of concrete beams, which will serve to support the bottom of the tanks. The sides of the tanks will be constructed in segments with the inner surfaces cylindrical and the outer surfaces flat. Each segment will be 10 ft. in height and will be 6 in. thick at the thinnest part The sumps are also of exceptionally strong construction and every care is taken to prevent any possible leakage. The earth is levelled and rammed, and then a layer of asphalt is laid down. On top of this the floor of concrete is built. The steel reinforcements in the floor are tightly connected with the sides of the tanks. The total capacity of the four sump-tanks is 750,000 gallons. In the refinery and clean-up house reinforced concrete is also used. The floor is several feet below the ground, and the sides of the house are constructed for the first few feet of thick retaining walls. Upon these walls are being erected the sides and ends of the building, the structure consisting of reinforced concrete slabs with a thickness of $4\frac{1}{2}$ in. The height of the walls to the lower side of the tie-beams will be 11 ft. The slabs out of which the walls are to be built are being formed on the ground. For instance the gable-ends, in pieces 17 ft. 6 in. by 22 ft. 6 in high, will be manufactured on the ground and subsequently raised and tied together in the same way as corrugated iron buildings. This plant may be taken as a type of the application of reinforced concrete to metallurgical operations on the largest scale yet attempted

Partridge Blast-Furnace.—In the *Western Chemist & Metallurgist* for February, A O Kellogg gives some particulars of the Partridge blast-furnace, in which the slag is used for the purpose of heating the blast. This furnace has been designed specially for use at mines where the output is not large, with the object of economically producing matte and bullion instead of shipping ores and concentrates to the custom smelters At the plant at Mexico City, where the author conducted his tests, the capacity is 5 tons of ore per day, and the plant shown in the drawing reproduced herewith is designed for a capacity of 20 tons per day The principle of the furnace is equally applicable to larger plants, but the object of the inventor has been rather to supply a want long felt among small mines than to apply economies on the large scale In this connection also the design has been arranged in such a way that none of the parts are too large to be carried on mule-back One of the novelties of the furnace is that the slag is discharged into small overlapping carriers mounted on an endless chain. This mechanism is enclosed in a brick tunnel, 29ft long, 6ft. 9in high, and 4ft. wide The tunnel is built in such a way that as little heat as possible is lost by radiation On arriving at the end of the tunnel the slag is tipped into water The air-blast passes up the tunnel and meeting the hot slag is raised to a high temperature The construction of the furnace itself is novel. Instead of tuyeres, there is a complete break between the shaft and the hearth, a space of two inches being left between them This part of the furnace is enclosed in a wind-box, and the blast enters all round the bottom of the stack In the plant illustrated, the stack is 7 ft high and 2 ft in diameter From the top a by-pass in the hood conducts the fumes to a dust-chamber and subsequently to a chimney The stack is water-jacketed, and the water from the jacket is conducted to the end of the tunnel where it is used for disintegrating the slag as it falls out of the train of carriers. The amount of water used is about 200 gallons per hour. The hearth or crucible is a light cast-iron cylinder, lined with fire-brick and clay, and mounted upon a four-wheeled truck. On the top of the crucible wall is a cylindrical extension or hoop which passes up into the wind-box. The crucible can be raised and lowered upon the truck by means of a screw. At the back is the tap for the slag which pours continuously upon the chain of slag carriers, and at the front and at a lower point is the tap for the matte. To start one of these furnaces, the crucible is first warmed by means of wood and charcoal burning within it, while it is standing away from the stack. When thoroughly heated it is wheeled into place, raised to its right position, and the joint between it and the wind-box tamped with clay. Fuel is then added from above, the blast turned on, and the charge gradually fed.



Small Partridge Furnace in Operation

In all small furnaces there is a liability of the charge freezing, owing to radiation, so that it is necessary to keep close watch, and holes are accordingly provided in the wind-box to allow of inspection and of the introduction of the necessary tools for removing accretions The fact that a hot blast is employed is all in favour of the small furnace from this point of view, as it will to some extent prevent chilling, though to be absolutely effective the blast would probably require to be hotter than it can be made by means of the slag Mr Kellogg reports that in his tests the hot blast and continuous wind-space made it possible to push the furnace to an unusual extent, and that silicious charges may be smelted without trouble. He gives the details of some of the runs in the 5-ton furnace In one case the ore averaged 9·6% copper, 4 dwt. gold, and 16 oz. silver, the silica was 59%, and there was also 13% of iron. Iron and lime flux was added so as to bring the assay of the charge to 4·94% copper, 32·5% iron, 13·8% lime, and 37·7% silica. To this charge was added 13% coke, carrying 14·7% ash. The result of the smelting of 3·9 metric tons of charge containing 1·95 tons of ore was as follows: 100 kg. bullion containing 55 gm. gold, 5900 gm. silver, and 83% copper; 170 kg. matte containing 34½ gm. gold, 2859 gm. silver, 55% copper, 18·4% iron, and 21% lime; and 3400 kg. slag containing 0·3% copper and 30 gm. silver. Thus 94% of the copper, 88% of the silver, and all the gold was recovered. It will be seen therefore that for a small furnace, the amount of fuel used was slight, though of course the proportional figure is large compared with the consumption at some of the gigantic smelters. The utilization of the heat of the slag is therefore an important factor in making the small furnace a practical success.

Analysing Rand Results.—In the *South African Mining Journal* for March 5 an outline is given of Hugh F. Marriott's new system for recording the development, output, cost, and profit of mining on the Rand. The system is to be adopted at all the mines of the Wernher-Beit group. Briefly, the novelty lies in the fact that the 'cost and profit of mining per ton milled' is abandoned, and the 'cost and profit per square fathom of area exploited' is substituted. It has long been the complaint that 'the cost per ton of ore milled' is a delusion and snare and that calculations on this basis are of little value in indicating the most economical method of operation. Large tonnage at a low cost is not necessarily the criterion of the largest ultimate profit, and the manager who reduces his mining cost by one or two shillings per ton is not the one who necessarily gives the largest returns to the shareholders. It is too often a superficial and misleading catch-phrase. Mr. Marriott's system may be best outlined by reproducing the columns of his analysis-sheet as follows:

1. Area developed on plane of reefs in square feet.
2. Area stoped on plane of reefs in square feet.
3. Resultant average of stoping-widths by actual measurement.
4. Value of total gold contents of areas stoped as disclosed by block assay-plan of ore reserves in place.
5. Average gold content per square fathom stoped.
6. Value of total gold won.
7. Average amount of gold won per square fathom.
8. Percentage of recovery.
9. Mine working costs per square fathom over areas stoped on all reefs.
10. Proportion of accessory costs chargeable against annual profits per square fathom.
11. Average working cost per square fathom.
11a. Total working cost.
12. Total distributable profit obtained.
13. Distributable profit per square fathom stoped.

In columns (1), (2), and (3), the figures are to be subdivided so as to give complete details of the three reefs worked, namely South Reef, Main Reef Leader, and Main Reef. Each reef is treated as a separate mine, if worked separately; and when two are stoped together, they must be taken as one. The figures in column (5) are obtained by dividing those in column (4) by the total in (2), and those in column (5) by dividing (6) by the total in (2). The percentage of recovery (8) is obtained by dividing (6) by (4). Column (11) is the sum of (9) and (10), and (11a) the product of (11) and the total in (2). Column (12) is the difference between (16) and (11a), and (13) is the quotient of (12) and (2a). In all these calculations the cost includes every expenditure in connection with the company, and here again Mr. Marriott introduces a real and common-sense system. In order to show low costs, directors and engineers are too fond of talking about 'working costs,' including therein nothing but stoping and milling; most companies now include development and depreciation of plant as well, but few include administration expenses or taxes and royalties. Mr. Marriott holds that everything except expenditure on extensions of operations should be included in costs. We have only given an outline of the system, though a discussion in detail would show its many advantages. No doubt our readers can follow the outline and make deductions for themselves. We would point out that the system is only applicable to moderately regular deposits, and also that the analysis-sheets must not be used for comparison between different mines on the Rand, unless the full circumstances relating to the operations are also taken into account. It will be seen that a manager by studying his own sheet will be able to adopt the best method of stoping and sorting, without sacrificing to the fetish of cost per ton milled. The proposition of Mr. Marriott also involves the substitution of quarterly for monthly reports, an alteration foreshadowed in a tentative way by Mr. Reyersbach a short time ago. Mr. Marriott holds that the engineer can study the problem of economy more efficiently and with less clerical labour by quarterly figures than by monthly ones.

Sampling Copper for Silver Content.—In the March *Bulletin* of the American Institute of Mining Engineers, William Wraith gives a paper describing a systematic investigation into the methods of ascertaining the silver content of copper undertaken in the Washoe smelter, at Anaconda. The research was made because the samples of the blister copper coming from the converters did not always agree with those taken from the anodes. The method of sampling the anodes is that devised by Edward Keller, and consists of making a drill in 99 positions indicated by holes in a template. At the furnace two methods are used, the chief one being to hit the stream of molten metal with a wooden paddle and thus project a portion into water where it is granulated. The other is to take a ladleful of metal from the stream and pour it into water. Prolonged investigations showed that the first of these two smelter methods gave results agreeing fairly closely with the samples of the anode, but that the second was found to yield higher silver contents than either of the other two. It was ultimately found that in the samples taken in the ladle the silver tended to segregate into the portion that cools last. Consequently the part that poured out most readily and was used as the sample contained more silver than the portion that had commenced to solidify round the sides of the ladle. Thus the sample was always higher than the average.

Regrinding at Broken Hill.—In Vol. XIII of the Transactions of the Australasian Institute of Mining Engineers, W. E. Wainwright and W. J. McBride describe experiments made at the Broken Hill South Silver Mining Co.'s mill, with a view of finding the relative efficiencies of tube-mills and wheeler pans for re-grinding the tailing from the jigs preparatory to re-treating it on Wilfley tables. The general result of the trial was that the cost of crushing in a tube-mill was much less than in the pans. The ore at the South mine assays on the average 15½% lead, 12% zinc, and 5 oz. silver, and its mineral composition is approximately 18% galena, 23% blende, 7% antimonial pyrite, 30% quartz, 7% calcite, 9% rhodonite and garnet, 3½% felspar, and 2½ fluorspar. This is crushed in rolls and treated in May jigs for the recovery of galena, and the tailing from the jigs is re-ground and treated on Wilfley tables and Luhrig belts for the purpose of recovering a further amount of galena and of producing a zinc tailing and a quartz tailing. It was with the object of finding the most economical plant for re-grinding the jig tailing that the present experiments were undertaken. The experiments also threw much light on the distribution of the lead, zinc, and silver in the various sizes of the products, and in this way helped the authors to obtain closer separation, but this part of the paper is to some extent out-of-date already, as the authors have since obtained additional results which have enabled them to still further improve the concentration. Consequently we confine this abstract to an account of the experiments with re-grinding. In the experiments about 11% of the ore was extracted as lead concentrate in the jigs. This contained approximately 47% of the lead and 35% of the silver in the ore. The jig tailing to be re-ground contained 11% galena, 30% blende, 9% calcite, 2½% fluorspar, 36½% quartz, 9% rhodonite and garnet, and 2% felspar. The plant in the competitive tests consisted of a tube-mill and six wheeler pans. The tube-mill measured 13 ft. 1½ in. by 4 ft. 7½ in. inside diameter without liners, and was lined with 1¾ in. cast-iron liners and with 3 in. by 2 in. cast-iron bars arranged longitudinally 18 in. apart. The flints at first recommended for use were eventually replaced before the tests begun by 8 in. cubes of the hardest parts of the quartz and rhodonite found in the ore. In the tube-mill test 10·9% of the ore was removed in the jig as lead concentrate and 89·1% sent to be re-ground. The following are the screen-analyses of the feed and the delivery.

Size		Weight % feed	Weight % delivery
On	10	8·6	—
,,	20	25·1	1·7
,,	40	22·5	9·5
,,	60	10·3	32·5
,,	80	1·8	2·0
,,	100	3·1	8·8
,,	120	4·9	9·5
,,	140	1·4	2·9
,,	160	1·5	3·7
Through	160	11·8	29·4

It was found that 8·6 tons was treated per hour, at an expenditure of 28 horse-power. In the wheeler-pan test 11½% of the ore was removed in the jig and the remaining 88½% sent to the six pans. The screen-analyses of the feed and delivery were as follows:

Size		Weight % feed	Weight % delivery
On	10	8·7	—
,,	20	24·2	1·6
,,	40	22·7	11·5
,,	60	21·2	29·1
,,	80	2·0	3·7
,,	100	4·0	7·8
,,	120	5·2	10·1
,,	140	1·0	3·7
,,	160	1·0	4·0
Through	160	10·0	28·5

The pans each treated 1½ tons per hour and each consumed 10 horse-power. In calculating the relative efficiencies, the reduction in size, the amount crushed, and the power consumed must be taken into account. The efficiency of crushing is figured by the author from the screen-analyses by the Klug-Taylor methods, and the relative efficiencies of the tube-mill and pans are found to be 576 : 565. The amounts of work done by the two types of machine per hour are 119,051 : 20,358, and per horse-power per hour 4252 : 2036, or practically 2 : 1. The screen-analyses and assays of the various products obtained by both methods of crushing and by subsequent concentration are given in great detail by the authors. The general inference is that the pans give a better product for table concentration but the difference is not great. The results show that in order to get a good recovery of lead out of the jig tailing crushing must be carried far enough to allow the bulk to go through an 80-mesh screen, and naturally as already well known the sliming and consequent loss of some of the mineral cannot be obviated if an efficient separation of the lead from the zinc is to be effected. In the tests it was possible to obtain lead concentrate on the Wilfleys equal to from 7½ to 8% of the ore; that is to obtain in the jigs and tables 80% of the total lead content of the ore and 64% of the silver. As regards the separation of the blende, the results in the present paper do not show a perfect separation into zinc tailing and quartz tailing, for the zinc tailing does not contain more than from 47 to 49% of the zinc content of the ore. According to the most recent reports from the mine, the recovery has been greatly improved since this paper was written, and the figure has been raised to 60%, a fact which shows that the authors' researches have been to some purpose.

Smelter Fume at Salt Lake.—For some years a battle has raged between farmers and smelters in the Salt Lake Valley, Utah. Two of the smelters have closed, and a third has made a compromise by agreeing to pay the farmers an annual indemnity. The fourth, belonging to the United States Smelting Co., set to work to devise methods for stopping the escape of sulphuric acid and metallic fume. The metallurgists have been successful in their endeavours and the Court has allowed the lead furnaces to resume operations. It is expected that the copper furnaces will also receive the official sanction before long. *Mines and Minerals* for March contains an account written by L. A. Palmer of the plant for arresting the noxious gases and fume. As regards the metallic fume, the usual bags are employed, and the novelty introduced consists in the method of neutralizing the sulphuric acid. We gave a short account in our December issue of the patent covering this method granted to C. B. Sprague. At the Midvale plant fume and acid are given off at three points of the process, from the pot-roasters, the reverberatory roasters, and the blast-furnaces. At the first named about three-quarters of the sulphur in the ore is removed and the resulting material contains 5% of sulphur. About 4% of the lead is volatilized, half being caught in the flues and the remainder in the bag-house. The reverberatory roasters treat the matte from the blast-furnaces, and reduce the sulphur content from 23% to 5½%. The gases from the pot-roasters and the reverberatories contain sulphuric acid (SO_3) as well as sulphurous acid (SO_2), but those from the blast-furnaces contain only SO_2. There is no objection to SO_2 escaping into the atmosphere, as it is disseminated in the air without settling, but the SO_3 unites with the moisture of the atmosphere and forms H_2SO_4 which settles upon the vegetation and otherwise does damage. The gases from the blast-furnaces are therefore allowed to go to the bag-house direct, but those from the two types of roasting-furnaces receive special treatment for the removal of SO_3. This is done by neutralizing it by means of lime and zinc oxide. By the side of the brick flue into which the gases and fume from the pot-roasters are discharged is built a brick furnace 20 by 8 by 6 ft. This furnace is fired with slack coal placed over a layer of limestone to which a small proportion of zinc ore or concentrate is added. The layers of fuel and limestone are fed alternately in thin layers. Air is blown into the furnace under pressure. The zinc is oxidized and the limestone burnt, and they are carried with the gases of combustion out of the furnace into the brick flue containing the gases and fume from the pot-roasters. Here they serve to neutralize the SO_3, which is precipitated as sulphate of lime or as zinc sulphate. The gases and fume from the reverberatories are treated in a different way. There is not so much SO_3 in them and the neutralization is effected by the introduction of crushed lime into the flues. On the other hand they require special attention owing to their high temperature and they are therefore sent through steel pipes which are exposed to the atmosphere. If their temperature was not reduced they would destroy the bags quickly. The article contains a description also of the bag-house and of the refinery for recovering arsenic from the flue-dust.

BOOKS REVIEWED

ORE AND STONE MINING. By Sir C. Le Neve Foster. Seventh Edition, revised by S. Herbert Cox. Cloth 8vo. 830 pages. Ill. London : Charles Griffin & Co. Price 28s.

This is the seventh edition of a standard text-book, now generally used in schools of mines wherever the English language is spoken. The present edition is noteworthy as having been revised by Mr. S. Herbert Cox, the professor who fills the chair formerly occupied by Le Neve Foster. It will be remembered that Bennett H. Brough revised the sixth edition and added the bibliography. Mr. Cox states that he has "refrained from extending the scope of the work," which now covers nearly 800 pages, but we are glad to note his promise to enrich a future edition with ampler reference to the business methods incidental to modern mining. When this edition is made the book will either have to appear in two volumes or be printed on thinner paper ; otherwise the bulk of it will make it clumsy, as a text-book. We note, however, that while the book, when first issued in 1894 was named 'A Text-book of Ore and Stone Mining,' it is now called 'A Treatise on Ore and Stone Mining.'

The first chapter, on the occurrence of minerals, has been but little altered save for one or two paragraphs outlining the development of current theory on the origin of ore deposits. Some additional matter on phosphates and on quicksilver also appears in the later editions. The five pages on 'faulting' are unchanged, for they needed no change. In fact, this first chapter is in Le Neve Foster's best style, and affords a delightfully concise summary of a subject the voluminous character of which is suggested by the nine pages of bibliography.

In the second chapter, now named 'Discovery,' and formerly called 'Prospecting,' we find some re-arrangement. Among additions are paragraphs on the significance of old workings, with particular reference to the re-opening of the Espiritu Santo mine by E. R. Woakes. Two pages of bibliography are added. The third chapter, on 'Boring,' now includes a description of the Calyx and Keystone drills, as well as a detailed account of prospecting core-drills, with reference to the latest practice in West Africa and Australia. The bibliography occupies one new page.

In the fourth chapter, on 'Breaking Ground,' we find that the description of dredging has been lengthened so as to include a short account of bucket-dredges as applied to gold-placer mining. An excellent photograph of an Oroville dredge is added, but the treatment of the subject is inadequate. The description of typical prospecting drills has been modified in accordance with later experience. The Darlington and Hirnant drills have passed out of use and the new edition recognizes the fact. In their place the Holman and Ingersoll-Sergeant are described, and the Temple electric-air drill wins honourable mention. The importance of drills for stoping is explained, with reference to hammer-machines, such as the Leyner. The description of machines "for excavating complete tunnels" is not as up-to-date as it should be ; two or three of the latest inventions are overlooked. At the end of this chapter two pages of bibliography are given.

'Supporting Excavations' is the title of the fifth chapter. Here we find that the description of the timbers used in mining has been considerably revised and enlarged. Otherwise no important change is to be detected, and no additions can be noted save the bibliography at the end of the chapter. In Chapter VI, on 'Exploitation,' we find a new paragraph on Lake Superior methods, and an amplification of the paragraph devoted to the variations in underground practice. A couple of pages on shaft-pillars have been added, together with a bibliography.

In the seventh chapter, on 'Haulage,' the original error of the author in using 'shoot' for 'chute' is perpetuated in the latest edition. No new illustrations of the many improved forms of ore-cars are given, although in this branch of mining equipment many noteworthy modifications have been made. Electric traction underground has undergone striking development since the first edition appeared, but the one page devoted to this important subject remains unchanged. 'Conveyance by boats' underground receives almost equal consideration, although as a means of haulage it is only a curiosity. An addition has been made by describing the transport of iron ore on the Great Lakes, but the description of wire-ropeways is based on information 20 years old. In Chapter VIII, on 'Hoisting,' a description of compound engines is noteworthy, with special reference to Lake Superior practice, and a few lines have been added to the paragraph devoted to winding by electricity. But here also the information is scarcely adequate. A couple of additional pages have been devoted to endless-rope hoisting in the Transvaal. This chapter is excellent in elucidating fundamental principles, but it requires modernizing. To 'Drainage' four or five pages have been added, besides the bibliography. The seven drawings originally used to illustrate the pumping plant in the Forest of Dean are omitted ; in their place we now have data concerning newer installations.

Similar comments can be made on the other chapters. Under 'Dressing' we find the old-fashioned illustrations of women sorting ore in antiquated ways instead of an up-to-date description of moving sorting-tables, travelling belts, and other devices now in general use. The bibliography occupies 3½ pages and includes most of the latest literature on the subject, but the text exhibits no borrowing from these sources. That is a criticism applying to the entire volume ; we began this review expecting to find many important improvements in the latest edition ; we cannot find them. The book is a useful volume because it was such in the first instance, but it has not been amended or enlarged in accordance with the advancement of knowledge on the subjects to which it is devoted.

T. A. R.

MINES AND MINERAL RESOURCES OF NATAL. By F. H. Hatch. Cloth 8vo. 155 pages with illustrations and maps. Published by the Natal Government.

Mr. Hatch was commissioned by the Natal Government to investigate the mineral resources of that country other than coal, and he spent eight months from April to November last year touring the districts where most was to be seen. The engagement was limited to this period, and it is obvious that in so short a time no close or detailed study could be given to any part of the colony. In fact, his tour was rather a journey of observation, undertaken with a view to seeing what has already been done, than a geological, mineralogical, or petrological enquiry. His first itinerary covered the districts adjacent to the railway between Dundee in the north and Shepstone on the coast to the south, all easy journeys from Pietermaritzburg. Subsequently he went into camp in Zululand, and afterwards travelled in the northern part of the colony in the Vryheid and Pongola districts.

He visited altogether 70 properties, of which 24 contained gold, 10 copper, and 10 iron, with smaller numbers containing tin, graphite, clay, phosphate, limestone, galena, manganese, asbestos, mica, and gypsum. He travelled 2265 miles by rail, and 1671 miles by road.

In the report now issued he gives a general outline of the geology of the country, and then proceeds to describe the occurrences of each metal and mineral mentioned above. Natal presents a great variety of physical and geological structure. The base of the country consists of a complicated series of pre-Cambrian rocks, such as schists and quartzites, with overlying Devonian sandstones and granite intrusions. Over the greater part of the country these rocks are covered by the Karroo beds, which correspond to the deposits from Rhaetic to Carboniferous. Prospecting for gold has been done on two classes of rock, the conglomerates of the pre-Cambrian age, and the quartz veins in the schists and granites of the pre-Cambrian series but of subsequent origin. The work on both gold and copper is centred in Zululand and in the Vryheid district.

The conclusions formed by Mr. Hatch are not at all rosy. He finds no large well-developed metal mines in Natal. The Wonder in the Pongola valley is the only gold mine that attracted his attention ; this has a small development of profitable ore and can be worked economically. The Denny-Dalton in the same district is low-grade and patchy, and the Golden Dove in Zululand is little more than a prospect Some of the other gold properties examined by Mr. Hatch have been extensively prospected and developed, but the results obtained did not impress him hopefully. As regards copper, he reports that the Subeni near Vryheid contains large bodies of low-grade ore that might pay if worked on a large scale. The Dania, also in the Vryheid district, contains a promising orebody of the same kind, but it has been traced for only 100 feet along the strike. Tin is worked in the pegmatite of the Umfuli valley, Zululand ; cassiterite occurs in large crystals, but the average content is too low to be profitable. Iron ore is found in the pre-Cambrian rocks in the form of ferruginous schist ; it contains too much silica and is not in sufficient quantity to be valuable. In the Karroo system there are extensive deposits of limonite, hematite, and magnetite under the coal measures. The ore is plentiful but will be costly to mine, and the absence of limestone will militate against smelting. The manganese ores are not of high-grade and could not compete with those from India.

It will be seen from this report that Mr. Hatch is not greatly impressed with the metal resources of Natal, as far as present discoveries are concerned, and with the facts and data made available for his use. It might possibly be a good policy to commission him again, but on different lines, with the object of obtaining his views of the prospects for future discoveries, based on a special geological and petrological study. Finally, we may add that with Natal it is not a question of waiting for improved communications, as with the Northern Transvaal, Northern Rhodesia, and the Congo Territory.

E. W.

THE CONDUCT OF AND PROCEDURE AT PUBLIC AND COMPANY MEETINGS. By A. Crew. 16mo. 150 pages. London : Jordon & Sons, Ltd. Price 2s. 6d. For sale by *The Mining Magazine*.

This little book has been prepared primarily for the use of secretaries, but it will prove useful to anyone called upon to preside over a public meeting. The first half of the book is devoted to the conduct of public meetings generally, and the second half to company meetings specially. An appendix includes definitions of terms, standing orders of the London County Council in regard to procedure at meetings of the Council, together with regulations appearing in the Companies Clauses Consolidation Acts, and other valuable information on the subject. A tabulated list of cases of disputed procedure is also furnished. Taken altogether this handy volume ought to be read by anyone likely to be put in control of a public gathering, whether social or technical.

GEOLOGICAL AND ARCHEOLOGICAL NOTES ON ORANGIA.—By J. P. Johnson. Cloth, small quarto. 104 pages. Ill. London : Longmans, Green & Co. Price 10s.

The author of this book is known as a writer on the geology, ore deposits, and archeology of South Africa, and we have already reviewed his book on metalliferous deposits in the Transvaal. Sometime ago he also wrote on the stone implements found in South Africa. In the present book the general appearance of the surface of Orange River Colony is first described and then the geology receives attention. The diamond ground is described in detail. Chapters are devoted to stone implements discovered in the Colony. The section devoted to the carvings and paintings on stone by aboriginal inhabitants is of particular interest. The agricultural prospects of the country are discussed, and the book closes with a bibliography.

BROKEN HILL MINES REVIEWED.—Pamphlet, 40 pages. London : *The Financial Times*. Price 6d.

This pamphlet contains a reprint of a series of ten articles that appeared in *The Financial Times* during January and February, and discusses the present position and prospects of the various mines and metallurgical businesses centred around Broken Hill. The articles were written from the point of view of the investor and they contain a pretty shrewd analysis of the situation. For instance the future of the Proprietary is well described. It is pointed out that though the ore resources are approaching depletion the company has an excellent prospect for the future as a custom smelter of both lead and zinc ores, that the company has millions of tons of residues ready for re-treatment, and that it also owns extensive iron ore deposits in South Australia. Other sections of the pamphlet discuss the position and prospects of the South, South Blocks, North, Sulphide Corporation, and of British, Block 14, and Block 10. In addition the position of the various companies treating zinc tailing is described.

CHEMISTRY OF CYANIDE SOLUTIONS.—By J. E. Clennell. Cloth, 8vo. 200 pages. New York : McGraw-Hill Book Co. Price 10s. 6d.

This is the second and revised edition of a book that has been of real value to cyanide chemists. The original edition was issued in 1904, and immediately attracted attention owing to the excellence of the contents, and also partly because the author's name was well known owing to his association with Charles Butters in early Rand days. The present edition contains about 35 additional pages reviewing critically the advance in knowledge and contributions to the literature of the subject since the date of the first edition.

CRYSTALLOGRAPHY.—By M. E. Wadsworth. Cloth, 350 pages with 25 plates and 612 figures. Philadelphia : J. J. McVey. Price 12s. 6d.

This book is by the professor of mining geology in the University of Pittsburg and it is intended as an elementary manual for the mineralogical laboratory.

CURRENT LITERATURE

Re-working Joplin Mines.—In *Mines and Minerals* for March, L. L. Wittich describes the work now being done in some of the old lead-zinc mines at Joplin, Missouri. In some cases the mines that had collapsed through inefficient methods of mining are now being developed by open-cast, and in other cases dumps and tailing-heaps are being re-concentrated.

Variations in Cyanide.—In the *Engineering and Mining Journal* for March 19, W. J. Sharwood joins in the discussion on the comparative cyanogen values of potassium and sodium cyanides.

Lead Concentration.—In the *Engineering and Mining Journal* for March 19, A. H. Fay describes the new 2000-ton dressing plant of the Doe Run Lead Co., at Flat River, Missouri.

Accidents in Mines.—In the January issue of the *Monthly Journal* of the Chamber of Mines of Western Australia, there is a well illustrated article on ambulance work in the Kalgoorlie goldfield, written by C. A. Bolton. Hints are given for removing debris without doing further damage to imprisoned miners, and improved stretchers are described for carrying the injured up shafts.

Cost of Producing Compressed Air.—In the *Canadian Mining Journal* for February 15, R. L. Webb gives an article fully illustrated with diagrams on the cost of producing compressed air for use in mines.

Small Smelting Plants.—In the *Engineering and Mining Journal* for February 26, Herbert Lang discusses the various causes of failure of small smelting plants.

Determination of Lead in Slags.—In the *Engineering and Mining Journal* for February 26, F. S. Schimerka describes a rapid method for determining in the wet way the lead content of chilled blast-furnace slag.

Accidents in American Mines.—In the *Engineering and Mining Journal* for March 5, F. L. Hoffman reports on fatal accidents in American and Canadian metal mines. The rate was 3·09 per 1000 below ground. He compares this rate with that of other countries and suggests more effective regulations.

Smelter Fume.—In the *Engineering and Mining Journal* for March 5, C. B. Sprague describes in detail his method of neutralizing acid gases and saving metallic fume, in use at Midvale, Salt Lake Valley, as outlined in our issue of December last.

Electrolytic Copper Refining.—In the *Australian Mining Standard* for February 16 and 23, and March 2 and 9, H. Schroder describes the three electrolytic refining plants in Australia, with all of which he has been connected, the Wallaroo & Moonta, the Great Cobar, and the Port Kembla.

Rock-drill Bits. — In the *Mining and Scientific Press* for March 5, T. H. Proske discusses the various forms of bits for rock-drills, and their applicability to various kinds of rock.

Nicaragua.—In the *Mining and Scientific Press* for March 5, W. A. Connelly describes the Piz-Piz gold mining district in Northern Nicaragua.

Dredging in Alaska.—In the *Mining and Scientific Press* for March 5, W. H. Washburn describes the pony-dredges employed at various parts of Alaska. These dredges being small and easily transported are useful in working shallow deposits.

Nitrate Deposits of Chile.—The *Journal of Geology* for January-February contains an article by R. A. F. Penrose on the nitrate deposits of Chile.

Gold Mines of Tibet.—In the *Mining and Scientific Press* for February 12, Alexander Del Mar gives a historical account of mining operations in Tibet.

Cyanidation of High-grade Slime.—In the *Mining and Scientific Press* for March 19, A. E. Drucker describes a combined air-agitator and continuous leaching vat for cyaniding high-grade slime.

TRADE CATALOGUES

MINE TELEPHONES.—Bulletin 1000 of the Stromberg-Carlson Telephone Manufacturing Co., of Rochester, New York, gives the latest forms of their Mine-a-Phone system.

F. W. BRAUN, of Los Angeles, sends us his catalogue of laboratory materials, appliances, and apparatus, extending over 500 pages. The firm has a large branch establishment at San Francisco, and probably has the most extensive business in this line in the West of America and Mexico. The gasoline assay-furnace has a vogue in other countries also.

L. S. PIERCE, of Denver, sends the latest circular descriptive of his gold separator and amalgamator, which is already well-known.

THE BANKA HAND DRILL for prospecting work is described in a new pamphlet issued by the makers, Werf Conrad Limited, of Haarlem and London. This is the oldest form of prospecting drill, having been originally invented in 1858 for the purpose of testing ground on the Dutch Government tinfields in the Island of Banka, East Indies.

THE FRANCIS-RAPID CONCENTRATOR is the invention of A. A. Francis and is made by Bowes Scott & Western, London. This table in addition to the usual longitudinal motion has also a lateral rocking motion for the purpose of increasing the efficiency of the washing action of the water.

LOW-PRESSURE STEAM TURBINES are described in a catalogue issued by Michael Pal & Co., Westminster. These are on the Schwarz system and are made by Louis Schwarz & Co., Dortmund. The heat accumulators of these turbines are an important factor in making the turbines available for utilizing exhaust steam from intermittently-working engines. Thus the steam from winding-engines at mines can be used for driving the turbines.

HADFIELD'S STEEL FOUNDRY CO., LTD., Sheffield, send us their new catalogue of rock-breakers, gyratory crushers, gold-dredge machinery, elevating and conveying plant, trommels, grizzleys, and other mining and metallurgical plant. The wearing parts are all made of the "Era" manganese steel. The firm also make chrome steel shoes and dies and are specialists in steel castings generally.

THE MARCUS MINERAL CONVEYOR is described in a pamphlet issued by Head, Wrightson & Co., Ltd., Stockton-on-Tees. This conveyor consists of a steel trough supported on rollers, and by means of a slow link-motion receives a longitudinal oscillation which carries the mineral forward at a rapid rate. It is applicable as a picking and screening apparatus.

THE MINING ENGINEERING CO., LTD., Sheffield, send us their catalogue of special mining machinery, including the Meco rotary and hammer drills, oxygen reviving apparatus, pure-air rescue apparatus, rope greasers, etc.

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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CONTENTS.

REVIEW OF MINING

INTRODUCTORY.—The month of April has been marked by the proverbial showers and sunshine ; the rain of prospectuses has fallen with brief intermissions and the rainbows of the promoter have arched the financial sky with the spectral beauty of promise. For several days in succession the aggregate amount of capital solicited for subscription has ranged between four and five millions sterling. It has been a lively period for the brokers, for the financial Press, and for the speculative portion of the public. Rubber was much in evidence, but oil also has received attention. Shall we say that it gave fuel to the flaming excitement of the stock market or is it sufficient to say that an effort was made to mix oil with water ? In any case much watered stock has been turned into golden wine of late. The intoxication of success has excused a rapid succession of issues, subscriptions, and settlements, all presaging the transfer of large sums of money. Many who have ridden on the crest of the wave of this boom have won themselves a handsome fortune, and we congratulate them. Others are still riding the wave, and they will do well to land on a rock before the receding tide takes them out to sea.

Imports of gold from America prevented a rise in the Bank rate and have helped London at the expense of New York. Activity in company promotion is unabated, the total offerings for subscription during the first four months of this year reaching a total of over 127 millions sterling, as compared to 80 millions in the corresponding period of last year and 182 millions during the whole of 1909. And while a tendency to financial indigestion has been developed here, it has been equally risked at New York, for in the first quarter of 1910 the applications for capital made by American railroads and industrial corporations reached a total of $644,734,000, as against $362,377,000 during the corresponding period in 1909. An increase of $282,357,000 would appear adequate to test the financially assimilative capacity even of a young Titan.

OIL. — The new Maikop district, in the Caucasus, concerning which we published an authoritative article in our last issue, has provided the motive for several important enterprises, but Trinidad, Roumania, Newfoundland, California, and other regions have had their names writ large on the pages of our daily Press and with equal insistence on the stubs of cheque-books. Maikop has drawn attention to the Near Eastern oil regions, belting Asia Minor from the Black Sea to the Caspian, from Tuapse to Baku. As yet the yield from the new district has not affected the statistics of production, but it is evidently destined to do so in the current year. During 1909 the petroleum products transported over the Caspian Sea to Astrakhan measured 1,221,805,410 gallons, as against 1,140,121,955 gallons in 1908. The shipments from Batoum during 1909 amounted to 173,823,585 gallons and in 1909 to 155,706,540 gallons. Russia has lost the Far Eastern markets and an effort is now being made to stimulate trade westward, especially to Great Britain. The cost of transporting kerosene from Baku to Batoum is 19 kopecks per pood (that is 5 pence per 36 pounds) and to this must be added 2 kopecks per pood for local port charges and other expenses. The cost price of kerosene at Baku in 1909 ranged between 25 and 32 kopecks per pood. Hence in exporting this product from Russia to Great Britain at 40 kopecks, the ruling rate, the exporters were making a loss. This explains the enormous decline in the Russian export of illuminating oil. A reduction in the rate for pumping light oil through the Baku to Batoum pipe-line would enable the producers to renew their old business connections with British and Continental importers. It is expected that the railway in question will accept the suggestion of the Tariff Committee to reduce the freight rate 7 or even 9 kopecks per pood, and so permit the Baku operators to enter the British market. Meanwhile a new railway from Armavir, through Maikop, to the port of Tuapse, is being built, but slowly. Two pipelines are projected and are likely to be in service before the railway becomes available. In 1909 the production of crude oil from the Baku wells was 2,146,225,952 gallons, as against 2,043,125,000 in 1908, and 2,082,500,000 in 1907. A new oilfield is being developed near Shemakha, 40 miles from Baku. The British consul reports that in 1908 an average dividend of 12% was paid by 14 companies, while 16 worked at a profit that was written off for depreciation and betterments, leaving only 7 that operated at a loss. Of these failures, three were British companies.

Among the Maikop flotations is a company organized by Mr. C. A. Moreing, who has taken the opportunity to give a participation to two Australian 'deep lead' companies (Moorlort and Victorian), which were failures, but possess funds wherewith it is hoped to retrieve their fortunes. Thus the shareholders will have an excellent chance to recoup their losses. Incidentally we note that the surviving deep lead enterprise, the Berry United, has suspended operations.

Among those prominent in the Maikop oil flotations is Mr. H. C. Hoover: in some of these same companies Mr. F. W. Baker has participated, but his chief financial successes recently have been in rubber issues. Mr. Edward Hooper is a director in one of the new oil companies. The firm of Thompson & Hunter has appeared as technical advisor on several prospectuses, but engineers versed in oil affairs are scarce at present in London.

We publish a short article on the California oilfields, the interest in which has undergone a marked revival. It is noteworthy that F. W. Bradley, M. L. Requa, and other engineers connected with successful metal mining in America have turned to oil exploration in the Coalinga district. In Mexico the dominant fact is the competition between Sir Weetman Pearson, or rather his firm S. Pearson & Son, and the Standard Oil Co. Apparently the big American oil trust is sensitive to the Pearson opposition, for Henry Clay Pierce, one of its agents, has published a brochure on the oil 'war.' The enterprising British firm of S. Pearson & Son, which built the Tehuantepec railway, is credited with controlling 27% of the retail oil trade in Mexico, thereby interfering with the monopoly of Mr. John D. Rockefeller and his friends.

SOUTH AFRICA.—A cablegram from Johannesburg states that earth tremors coincided with a fall of rock in the upper disused levels of the New Goch mine. Such occurrences will be frequent as the old workings collapse, producing concussions similar in effect and origin to the 'air-blasts' that occasionally disturb the communities living above the cavernous workings of the old copper mines of the Lake Superior region.

The ore reserves now developed in the mines of the Rand are estimated to contain £100,000,000 in gold, of which £40,000,000 is profit. The large consolidations of property recently formed are strengthened by the proving of enormous reserves of profitable ore. Thus Sir George Farrar stated that at the end of the current year the East Rand Proprietary will have 12,000,000 tons available for stoping, containing £17,000,000 in gold. Mr. George E. Webber promises that the Crown Mines will have 11,000,000 available at the end of 1911. The Robinson has 2,000,000 tons in reserve, and in the Cinderella Consolidated 3,500,000 tons is to be blocked out during the next four years. Up to date the banket beds of the Main Reef series have yielded £265,000,000 in gold. Such figures outline the magnitude of the mining industry of the Rand.

RHODESIA.—A rise in Shamva shares reflects the satisfactory news concerning the development of the Abercorn deposits. According to Mr. Hans Merensky the ore exists in a shear-zone traversed by numerous small quartz veins. The deposits resulting are irregular in structure and not comparable to the continous layers of conglomerate exploited on the Rand. Pebbles do exist in some of the ore, but it is not a true 'banket'; in the Shamva the sheared zone is in quartzitic sandstone containing some layers of conglomerate but elsewhere in the vicinity the sandstone, which has been metamorphosed and tilted, is crossed by gold-bearing stringers of quartz constituting irregular masses of low-grade ore. An average of 4 dwt. stuff is mentioned. At the Globe & Phœnix the presence of antimony is hindering the treatment of the rich ore, the extraction declining to 69% as compared to an average of 75·66% last year. Even that was a poor metallurgical showing. It is a pity that fuller information is not published, for it might lead to valuable suggestions from men who have had experience with similar ore.

WEST AFRICA.—During the month attention has been drawn to the southern end of the Tarkwa banket range by the favourable reports from the property of the Tarkwa West company. Mr. F. J. Dowding, the engineer in charge, was present at the meeting of the subsidiary company, the Tarkwa Boring Co., and gave particulars. The banket in this district contains larger pebbles than found elsewhere, many being 6 inches in diameter; the gold also is coarser and more patchy. Three ranges of hills traverse the Tarkwa West property and banket deposits outcrop on both sides of each range. The connection between the orebodies thus exposed has not yet been determined.

A circular has been issued by the Ashanti Goldfields Corporation summarizing a report by Mr. W. R. Feldtmann, who has just returned from a visit to West Africa. He announces that the new metallurgical plant will be ready in June, and also that developments continue to go ahead of the extraction. Last year the discoveries of rich ore on the Obuasi workings was one of the events of the day; it appears that the rich shoot is not going down far, for on the seventh level the gold content is low. On the other hand, the developments at the 6th, 7th, and 8th levels on the main or Ashanti orebody are excellent, and more than make up for the decrease at Obuasi. At Justice's mine the extent of the orebody on the No. 3 level has not yet been exactly ascertained, but there are signs that it is shorter and narrower than at the upper levels.

WEST AUSTRALIA.—Shares are inactive, for lack of news. The report of the Chamber of Mines, issued at Kalgoorlie, shows that the decrease of gold from Western Australia last year was only 19,685 oz., which is the smallest decrease since 1904, when the output was nearly 2,000,000 oz., or 500,000 oz. more than in 1909. However, it is pleasing to note that the Kalgoorlie district did better in 1909, increasing to 896,900 oz., as against 888,415 oz. in 1908. This slight gain was made in spite of a shortage of 9000 oz. in the production of the Great Boulder Perseverance, which suffered from a fire early in November. The big mines continue to give promising results in depth, that is, down to 2600 ft. The railway extensions from Mt. Magnet to Sandstone and from Nannine to Meekatharra will facilitate mining in the East Murchison and Murchison districts.

INDIA.—The greatly improved position of the Ooregum mine, in the Kolar group of gold mines, is of importance and it adds to the interest caused by the excellent reports from the Mysore and Nundydroog, as noted in our March issue. The Ooregum has been a producer for 22 years and it has experienced periods of depression. Three years ago the recovery fell to $8\frac{3}{4}$ dwt., and the fact that for 1909 the figure rose to $12\frac{1}{2}$ dwt. has had satisfactory effect on dividends. The developments in depth are most encouraging and the prospects are as good as at any time during the life of the mine. As against the present prosperity of Mysore, Nundydroog, and Ooregum, the Balaghat, which is the most northerly of the group, finds itself in a precarious condition. For many years the development work was not rewarded with a profitable discovery, and it was not until 1900 that a dividend was paid. The profits then gradually rose, but in 1905 the output fell away, and despite active prospecting and development no new orebody has been found. The reserve is now practically exhausted, and plans for the future are under consideration. It is also a matter for regret that the Hosur Co., operating in the Dharwar district, has had to suspend operations. This company was a continuation of the Coromandel, which was one of the Kolar group; on the failure of that mine, the Hosur was acquired, and the results have been consistently unsatisfactory. The Dharwar district has proved a disappointment.

UNITED STATES.—On May 2 the Senate passed the bill, previously accepted by the House of Representatives, creating a Bureau of Mines in the Department of the Interior. This bill has been the subject of much controversy, being opposed by the friends of the Geological Survey, which has already established a technological branch for the investigation of mine explosions, accidents, and other features not directly related to economic geology. The passage of the bill will please the mining people of the Western States.

Anxieties due to trust - busting legislation, the injury done to cotton crops, the outflow of gold, and the weakness of the copper market depressed New York during April and culminated in a heavy relapse in share - values early in May. The copper position has not really altered, but the effort to divert attention from unpleasant economic facts by means of mergers, consolidations, and other plays with the counters in the game of speculation, has finally failed to obscure the true statistical position. The fact is that during the industrial depression of 1907–1908 the production of copper was not checked so that the stock on hand increased; since then a revival of industrial activity has sufficed to absorb the greater output of metal due to the 'porphyry' group of mines in Utah, Nevada, and Arizona, but it has failed to liquidate the excess of metal accumulated two years ago. Just now the American output is gaining slightly on the consumption and export, the stocks are increasing, and the facts will have to be faced. The dominant feature is that a group of new mines has come forward able to deliver a large quantity of copper at a cost of from 8 to 9 cents per pound; obviously the maintenance of copper at 13 cents depends upon the relative proportion of cheap copper available. When the mines yielding copper at a cost that leaves a slight, if any, margin of profit cease to produce, then the supply will diminish and stocks will be absorbed. But it happens that some of the mining companies producing copper for about 11 cents per pound are useful as market counters, and in the fluctuations of their shares a few rich men make recurrent profits on Wall Street.

Some excitement has been caused by discoveries at Jarbridge, in the northern part of Elko county, Nevada. The new camp is 95 miles from Twin Falls, Idaho. The claims already located cover both sides of the Jarbridge river, which feeds the Bruneau, a tributary of the Snake. On the precipitous sides of a deep canyon a series of dikes of silicious rhyolite (possible 'alaskite') show bold outcrops 10 to 30 ft. wide and assaying from 8 to 10 dollars in gold. The precious metal is found native and associated with silver sulphides.

Among the April flotations was the Frontenac Consolidated, a group of mines in Gilpin county, Colorado. Favourable reports have been made by Messrs. Henry P. Lowe, Forbes Rickard, and the firm of Alexander Hill & Stewart, so that the enterprise is well authenticated. The Aduddell and Frontenac are old mines with a good record and can be operated economically through the Newhouse tunnel. Ore reserves yielding a net return equal to the issued capital of the company are estimated to be available, therefore the undertaking bears the promise of success.

Our San Francisco correspondent refers to the compromise effected by the Bunker Hill and Federal companies; this is important as ending litigation between the two most productive groups of lead mines in America. The Federal company has been most unfortunate lately and now loses its right to extract ore near Wardner; on the other hand, the Bunker Hill company is prospering, not only in its litigation, but in the discovery of fresh ore-bearing ground.

The attempted flotation of the Natomas bonds in London proved a 'frost,' only a few thousand pounds being subscribed by the public. Another placer-mining proposition, the Aporoma of Peru, will be offered shortly. Interest in East Siberian and Colombian alluvial deposits is manifest in several quarters.

SOUTH AND CENTRAL AMERICA. — We publish an interesting letter from our correspondent at Lima.

An earthquake has shaken the Central American states, particularly Costa Rica, but seismic disturbances injure those unstable republics less than the political revolutions with which they are synonymous. Nicaragua is interesting as a mineral region of great promise; just now it is in the condition of a cyanide vat undergoing an agitation preventing settlement of its valuable contents. Early in April the revolutionary forces almost reached the capital, but were outnumbered. After inflicting heavy losses they retired and assumed an impregnable position at Rama; at the same time the Government troops concentrated at Acoyapa, which is also strongly fortified. Both parties are resting and waiting, the wet season is due, and it is expected that the rain will dampen the martial spirits of the combatants. The intervention of the United States has proved a fiasco; having removed one President it seems illogical to leave the country in the power of his satellites. Meanwhile we are informed by our correspondent that mining is stagnant. Labour is scarce, for the natives not in hiding are being recruited as soldiers. Transport is paralysed, for the mules and oxen have been commandeered and the freighters are afraid to risk the loss of their animals by using them on the roads. "Guarantees of safety and exemption from service" are issued by the Government only to be withdrawn without notice, a file of soldiers swoops down on the *hacienda*, the workmen are pressed into service, and operations cease perforce. 'Voluntary' contributions are levied on the owners of property and even foreigners deem it wise not to claim exemption. The goodwill of the authorities is an expensive luxury, and it does not suffice to secure immunity from interruption. A surveying party with a transit, for instance, is mistaken for the enemy with a machine gun, and is exposed to volleys that fortunately injure the scenery but miss the engineers. Such incidents dissipate *ennui* but hinder the technical operations necessary to the exploitation of mines. To be a mine superintendent under such circumstances requires exuberant cheerfulness. Watched by disconsolate buzzards and regarded askance by mournful natives, with the ghost of fever and the wraiths of rheumatism hovering at each elbow, cut off from news of home and bothered with rumours concerning the marchings and counter-marchings of a childish revolution, the man in charge of a mine deserves more credit than he gets and more sympathy than he asks. We send him greeting; he is not forgotten.

EDITORIAL

MINOR current events are completely eclipsed by the death of King Edward. It is proper, even in a technical journal, to express the deep regret of all Englishmen in the loss of a King who fulfilled his royal functions with infinite tact and performed his personal duties with a sagacious kindness that endeared him to his people. As a constitutional monarch he greatly strengthened the system of government under which the Empire has so conspicuously prospered and as the titular head of the nation he exerted a profound influence in the maintenance of peace throughout the world. He gave peace; peace be with him. International strife is hushed in sorrow. The muffled drum beats a solemn dirge that belts the earth; the British flag flies at half-mast from the tropic islands to the arctic plains; and while the mournful echoes still linger the silver trumpets sound a cheerful call to the new day, heralding the reign of George the Fifth. The King is dead; long live the King.

OWING to the death of the Sovereign the dates of all proximate public gatherings are cancelled. The Institution of Mining and Metallurgy will meet on May 26, instead of May 19, and the dinner of the old students of the Royal School of Mines is postponed until November.

IN our last issue we expressed the general interest felt by technical men in the presentation to be made to Dr. R. W. Raymond on the occasion of his 70th birthday, and we endeavoured to convey the good-will of the English members of the profession toward a man who has done splendid service for the industry of mining and for the allied arts whereby mineral wealth is won from nature. With keen pleasure, therefore, we now chronicle the further fact that the gold medal of the Institution of Mining and Metallurgy has been awarded for this year to Dr. Raymond, the award having been duly made known at the public dinner given in his honour at New York on April 30. We note that the medal was bestowed "in recognition of his eminent services and lifelong devotion to the advancement of the science and practice of mining and metallurgy; and of his numerous valuable contributions to technical literature." This is well expressed: the award was peculiarly proper and delightfully timely. *Glück Auf.*

THE MINING & METALLURGICAL CLUB, having obtained a name in April, has acquired a habitation in May. The agreement for the tenancy of the premises at St. Ermin's, Westminster, has been signed and the re-decoration of the club quarters is expected to be finished by the middle of the present month. On April 14 a general meeting of those interested in the Club was held at Salisbury House ; this meeting proved harmonious and effective. In addition to the finance committee mentioned in our last issue, the general committee includes Messrs. Charles O. Bannister, Bertram Blount, W. A. Carlyle, R. E. Commans, S. Herbert Cox, André P. Griffiths, George T. Holloway, Alfred James, T. Bruce Marriott, Cyril E. Parsons, T. A. Rickard, George Safford, A. L. Simon, Vere Herbert Smith, and O. J. Steinhart. An inaugural dinner is to be held shortly with a view to launching this social enterprise on a proper footing.

ANNOUNCEMENT is made that the governors of the School of Metalliferous Mining, in Cornwall, have appointed Mr. W. Fischer Wilkinson as principal of this institution and that he will be in charge from the beginning of the next session, in September. Both by his academic training, at Harrow and Freiberg, and by his practical experience in South Africa, West Africa, Norway, and elsewhere, Mr. Wilkinson has acquired a sympathetic understanding of the nature of the teaching best suited to the development of efficient recruits for the industry and profession of mining. We understand that Mr. J. J. Beringer, to whom the high reputation of the Camborne School of Mines is due, will continue to give his aid in the training of young Cornishmen and the numerous other students coming to Camborne.

TECHNICAL MEN taking part in the mining and metallurgical work at Cerro de Pasco appear to be full of cheerful energy, as is shown by their spokesman, *The Inca Chronicle*, a copy of which has reached us. These progressive Americans have succeeded in overcoming both the *mañana* habit of the Peruvian and the *soroche* of the Andean altitudes. It was an experiment—on a large scale—to smelt copper ore at 14,000 feet above sea-level, and for a time the rarified air proved an obstacle to the operation of the blast-furnaces. Finally, it was ascertained that the weight of material smelted depends directly on the weight of air forced through the furnaces. Thus, the capacity of the blast-furnaces is decreased above 'timber-line.' It has been found, contrary to expectation, that a lower pressure of air at the blast gives the best results. Also a larger proportion of coke must be used in the charge. These facts having been ascertained by intelligent experiment, the smelting operations at La Fundicion are now completely successful. In 1909 the output was 32,106,116 pounds of copper, and the production continues to increase steadily. The Cerro de Pasco is a notable enterprise and we hope that it may prove abundantly successful.

THOSE who are united by the Atlantic will have shared a deep regret when it proved that this time the rumour of Mark Twain's death was not "greatly exaggerated." A fount of pure fun has ceased to flow ; we shall miss the bubbling humour wherewith the dry places of life were formerly gladdened. To Samuel L. Clemens it was given in rare degree to add to the gaiety of nations, and more particularly those English-speaking peoples whose ideas of humour differ so widely. Whether a joke ceases to be a joke when told to a Britisher or only when it is related by an American it is not possible for us to say for we derive delight from both contingencies. All of us are indebted to Mark Twain. He enriched our common language with Huckleberry Finn and the Innocents Abroad, with delicious antithesis, elliptical exaggerations, and intellectual surprises that are forever new. He was "a fellow of infinite jest." The best thing he ever said was that he had noticed that the British are mentioned in the Bible, for is it not written : "Blessed are the meek for they shall inherit the earth." From Calaveras to Virginia City, from the Comstock to San Francisco, from California to Jerusalem, from the Mississippi to the Thames, from Oxford to New York, he woke a laugh that lingers still. To his memory we offer the tribute of a smile.

SOME of our readers may wonder why we refuse to employ the prefix indicating that a man is a Doctor of Philosophy, although we often refer to the Secretary of the American Institute as Dr. Raymond. We hold that no university degree confers a title; an M.A. migbt as well be called 'Master' as a Ph.D. be addressed as 'Doctor.' Only physicians are so addressed, but not surgeons, dentists, or philosophers. A generation ago when the bearers of the Ph.D. degree were few in number, at least in English-speaking countries, the title of Doctor among scientific men was distinctive. Among these was R. W. Raymond; in his case the title has become part of his name, but we hold it an exception. Others could be quoted. We prefer to follow the lead of Samuel Johnson, who, although in receipt of a doctorate of laws from Oxford University, never signed himself or referred to himself as Dr. Johnson; he was Mr. Johnson when he was not plain Sam. Johnson. We deem it a greater compliment to a man to spell his name correctly, giving the initial or the fore-name, than to bedaub him with titles that have no significance unless it be stated exactly how and where they were obtained. The same holds true of the vulgar use of the prefix Professor. But that is another story.

LAST MONTH we suggested that the cubic metre was a better unit for stope measurement than the square fathom. For purposes of calculation the metre is a scientific unit, for, given the specific gravity of a substance, we at once infer the weight of a cubic metre of that substance, because a cubic metre of water weighs 1000 kilograms or 2204 pounds avoirdupois. Thus the specific gravity of quartz being 2·6, a cubic metre of quartz weighs 2·6 metric tons. But as the cubic measurement of a stope involves three dimensions, the superficial area of ground removed becomes obscured by multiplication into a variable width. Superficial area can be recorded on a map; cubic contents cannot thus be recorded. As it is not expedient to break ore for a uniform width, but rather to encourage the extraction only of the portion that is profitable, it becomes advisable to keep the stoping-width separate from the area, recording the latter on the map and the former in frequent cross-sections.

WE NOTE that "the rock of the Gwanda strike" is described by the curator of the Rhodesia museum as 'scorodite.' This inspiring piece of information is cabled from Bulawayo and affords an example of the pseudo-science that turns mining into *opera bouffe.* 'Scorodite' is not a rock but a mineral, namely, a hydrous arsenate of iron; it is not rare, and is likely to be found in connection with any gold ore containing arsenical pyrite. Under 'Company Reports' in January we quoted from the annual report of the Wheal Commerce mine, in which it was stated that the lode has been "cut out by a barren rock the nature of which was a puzzle to the engineers," whereupon the directors decided to stop petrographical discussion by calling it 'commercite.' We shall expect next to hear that a secondary enrichment of Wernherbite has been discovered in West Africa and that a dike of Marriotiferous graphite has crossed the Main Reef at Johannesburg.

IN THIS ISSUE we publish the first part of a comprehensive article on the concentration of lead-silver ore in the mills of the Bunker Hill & Sullivan company at Wardner, Idaho. The Bunker Hill group of mines is the most important source of argentiferous lead in the world; for many years it was second only to the Broken Hill Proprietary, and now that the great Australian mine is idle, the American mine takes the first place. However, the interest attaching to the technical description of the processes employed to treat the ore is independent of mere quantity : it depends upon the applicability of the information to similar problems elsewhere, and upon the manner of presentation. In regard to these factors the article by Mr. Gelasio Caetani is one that we are proud to publish. The author is peculiarly fitted to write intelligently on the subject, both in its general aspect and its local bearing. A graduate of the University of Rome and of the Columbia School of Mines, Mr. Caetani has been fortunate enough to combine a European with an American training, useful in itself but rendered intensely practical by a subsequent apprenticeship served successively in Colorado, Mexico, and Alaska. Having been called upon to criticize and investigate the methods of milling at the Bunker Hill, under the enlightened management of Mr. F. W. Bradley, he made a series of tests on a large scale and therefrom obtained a correct knowledge of the conditions modifying the milling process. Thus he became equipped to offer suggestions for bettering the methods in vogue, until finally it was decided to build a new mill on a design outlined by him. This mill has been erected and is doing excellent work. Now he is enabled to write on the technology of the concentration process in the light of daily demonstration, thus affording a delightful example of theory checked by practice, of practice illumined by science.

Clubs and Societies.

Our friend and honoured contributor, Mr. F. Lynwood Garrison, of Philadelphia, whose article on Colombia appears in this issue, together with a letter on the Mining and Metallurgical Society of America, takes us to task for our recent remarks anent that association of engineers. Of the several counts in his indictment we shall reply to the one presenting the most useful subject for controversy : the others we leave to the judgment of our readers. Mr. Garrison objects to our reference to the society of which both of us are members, and says : "You would not venture to do such a thing of any social club in which you are a member and it is hard to see much difference in propriety as regards the Mining and Metallurgical Society." Here we take issue on a fundamental question: to us the "difference" mentioned is as wide as the Grand Canyon of the Colorado ; indeed, the distinction between a "social club" and an engineering association goes to the very heart of the matter under discussion. We have criticized the Society for adopting the exclusiveness of a social club, while Mr. Garrison, and others influential in the management of the Society, blames us for failing to regard a national engineering organization as a social club. The point is worthy of elaboration, for it goes to the root of differences of opinion among members of our profession. To us it would appear obvious that an association of engineers living in various cities scattered across a continent, and including a number of groups of members so separated geographically that they rarely meet, is not like a social club, but is more akin to a political or athletic union. The fundamental distinction, however, is not based on any lack of personal contact, it is due to the fact that membership is dependent upon carefully prescribed qualifications as to occupation, experience, and skill ; these qualifications are as precise in the direction of professional aptitude as they are silent in regard to those indefinable qualities constituting sociability. On the other hand, while a social club prescribes no qualifications, it takes for granted one basic condition, namely, that the candidate to membership is congenial to those already in the club. The absence of any regulation specifying qualifications only brings into greater play this one factor. To exclude a man it is sufficient if some of the members do not like him ; he may be a first-rate citizen, a person of unquestioned ability, and even of high character, but if he holds views or has habits that would introduce a discordant element into the club, his proposer and seconder are asked to withdraw his name. No reason is required, the club has the right to elect whomever it pleases; and it pleases to elect those that are congenial. That is enough. You may prefer red-headed men to bald men, you may like a Democrat and object to a Republican, you may drive with a wooden club and exclude the fellow who uses an iron; any reason or none at all will equally suffice, for the arbitrament of choice depends on nothing but the personal predilections of yourself and your fellow members. You are not bound in any way to elect anyone, for you have published no description of the kind of man suitable for membership, you have imposed no qualification beyond the one perfectly well understood in polite society, namely, that a man must not be a felon, a bankrupt, or an imbecile. For the rest, we repeat, he must be congenial; that is enough. But an organization of professional—not social—units, belongs to an entirely different category. It starts by publishing by-laws defining minutely the qualifications required for membership, stating expressly the particular kind of man that is eligible. That eligibility depends not at all upon social qualities, but on profession aptitude. The candidate may eat peas with a knife and ice-cream with a spoon, he may prefer beer to burgundy, he may choose to dine in tweeds rather than twill, he may like a foul old pipe more than the most fragrant Havana that ever came from the Vuelta Abajo, his politics may be atrocious, and his golf unspeakable, but if he knows a mine when he sees one, can exploit a hole in the ground so as to make it richly productive, is able to make a refractory ore docile as a well bred filly, and can manage men like the first violin of an orchestra, then he is a mining engineer and is eligible for membership in the proudest professional association, always provided that he is not known to be dishonest, for, of course, known rascals are taboo in any congeries of honourable citizens. The point we are trying to elucidate is that the more precise and explicit the regulations embodying qualifications to membership, the less the excuse for exclusion when a candidate fulfils the published requirements. The closer the definition the less the difficulty of classification. Selection becomes automatic. By adopting by-laws prescribing just the kind of man deemed fit to be enrolled, the Society by so much diminishes its range of selection and by so much eliminates the exercise of such choice as is dependent upon the personal likes and dislikes of its existing members. Excellence as a mining engineer, as a metallurgist, or as an economic geologist, does not hinge upon the social qualities, although such qualities are always a factor of success in a civilized community. We go further: any society arrogating national or international scope, any society claiming to include all the properly qualified practitioners, any society assuming the function of professional classification, is in the position of a judge, not a host; of a public functionary bound to act in accordance with prescribed rules, not a private person free to give vent to his own idiosyncracies. We go so far as to say to the Mining and Metallurgical Society of America, the Institution of Mining and Metallurgy (London), and to similar representative professional societies that, having once laid down the qualifications necessary to membership, these societies have lost the right to pick and choose according to prejudice or pique; indeed, the right of a properly qualified man to membership is such, and the denial of admission may be so great an injury to his reputation as an engineer, that he would be entitled to bring a charge of slander against the society that refused to admit him after having published its notions of fitness so as apparently to include him; at least, like Kruger against the Jameson raiders, he might demand "moral and intellectual damages." A national engineering association is not a social club; for every right assumed it owes a corresponding duty, for every privilege that is accorded a compensating responsibility is imposed.

Technical Advice.

Any observant reader of the prospectuses appearing from day to day must have remarked that technical advice appears to be at a discount. That is one of the marks of a boom; the technical advisor, like the physician, is only in demand when the time approaches for an obituary. Every prospectus duly records the fact that the company has its directors, its bankers, its brokers, and solicitors. Occasionally it is suggested that these worthy gentlemen are starting on a journey across the troublous waters of finance fortified by the guidance of a navigator, but usually it is deemed safe to go forth on a calm sea with a ship's company that includes a number of respectable gentlemen but no one capable of taking an observation or handling the ship in a cyclone. Even the rubber industry is based on operations requiring specialized knowledge and it would be supposed that a technical advisor is essential. As for oil, the winning of that liquid mineral involves engineering and geology of a most skilful kind; yet most of the oil companies appear to be acting on the advice of brokers and solicitors. One firm of oil experts is apparently advising all the companies as yet awake to the need of such assistance, but we shall be much mistaken if this branch of mining engineering is not stimulated in the near future, for there is room for those having special experience in drilling for oil, in exploring oil-fields, and in the management of oil companies. However that may be, we do insist that it is a childish blunder to invest big sums of money in technical operations without the advice of men well versed in such matters. Brokers at least ought to understand this, for the omission indicates a weak point in the business. The bankers, of course, do not care so long as there is no overdraft; and as for the solicitors, the difficulties ensuing from the lack of technical advice lead to those very situations in which solicitors revel. But the brokers, we repeat, ought to know better; they ought to appreciate that a board of directors is largely ornamental and is useful as giving the stamp of sincerity to a prospectus, but the man behind the gun must be the technical manager on the spot or the specialist who advises that manager. It is a pity that legislation, which has done so much to protect investors and to correct abuses in financial excursions, should not be directed to this point. It would be as feasible to render it illegal to engage in drilling for oil or mining for gold without technical advice as to take a ship through a shoal without a pilot or give the command of a vessel to a dentist.

Per Square Fathom.

In our last issue we made reference to the introduction on the Rand of a new method for recording the progress of mining operations. In brief, the proposal is to cease using 'the ton of ore milled' as the basic unit and to refer all statements of yield, cost, and profit to 'the square fathom' of lode excavated. To Mr. H. F. Marriott we owe the suggestion, and to him naturally we turn for a full explanation of the scheme. Such an explanation he gave at a gathering of engineers at Johannesburg on March 23. An abstract of his remarks will be found in our Précis of Technology. The speech has been published in pamphlet form. We do not hesitate to discuss the subject again because it is obvious that unless fully explained and elucidated the innovation will puzzle the public and annoy the shareholders. Directors issuing reports expressed in terms not intelligible to the owners of a mine—namely, the shareholders—are properly subject to blame, and managers adopting cryptic methods of expression are not fulfilling the duty they owe to the aforesaid owners of the mine. We need hardly say that Mr. Marriott, as a worthy representative of the profession, is glad to give information and to assist honesty of administration. It is safe to assume that the leading engineers engaged in the technical management of the splendid mining enterprises now characteristic of the Rand are anxious to conserve the interests of the investor rather than those of the mere speculator, they desire to develop the features that make mining in the Transvaal a legitimate and safe business rather than a tricky and insecure gamble. Mr. Marriott's speech confirms such an inference; it is an earnest plea for straightforward accounts and perspicuous records. His proposal is the result of careful forethought; even the unit now adopted represents a choice from many that have been suggested. We have said that it is not new, but borrowed from Cornwall. This is true, but the application of the square fathom as a measure of mine development, mine exhaustion, and mine realization represents a new departure.

Like all other schemes for expressing a complex series of operations in statistics the advantage to be derived from the use of the square fathom will depend upon the sincerity and skill with which it is applied by the foremen, managers, and engineers. Apparently 'the ton milled' as a unit has lent itself to palpable insincerities. Managers have broken ore below the economic limit in order to increase their tonnage because thereby they diminished their cost per ton—which was taken as the complete expression of efficiency in management. In the stope it was deemed more convenient to break down poor ore than to keep it in place with the aid of timbers, and, in general, the idea of cost per ton tended to blind the staff to the realization of the fact that profit is the essential purpose of the manifold operations conducted in mines and mills. Of course, all mining engineers who have cut their wisdom teeth have grasped the idea that mining is not conducted for the purpose of academic success or technical display, but to win money by extracting metal from ore; unless a profit ensues the operation is a losing, not a winning, performance. By expressing results in pounds sterling per square fathom of lode this fundamental economic feature is to be accentuated. The mine maps will show blocks of ore on the plane of the lode and each block, having been sampled on all four sides, will be set down at an average yield per square fathom. The estimated cost of extraction will be recorded at so much per square fathom, and where a block is on the ragged edge of the economic limit the best policy will be to attack the richest part of the block, ceasing to stope when the unprofitable portion of the lode is reached in that particular block. Obviously if a block averages £18 per fathom and the average cost is £16 per fathom, it will be a blunder to extract ground yielding £12 or £14 per square fathom before reaching the better ore that may give £20 or £25 per fathom. We would have liked to see a cubic measure used, so as to include the third dimension, namely, the width, but it is deemed impracticable, and likely to mislead, because the stoping width is subject to frequent variation; indeed it is held that the effort to break to a uniform pre-arranged stoping-width is the cause of including an unnecessary proportion of waste, meaning thereby all lode-matter too poor to be profitably exploited. If a stope shows two or three feet of stuff below grade, it is cheaper to spend money in timbering to keep it in place for a later day, when the cost of mining has been further lowered, than to extract it now merely to swell the output. Apparently, the idea of a uniform width of ore in the banket layers of the Main Reef series has been the excuse for much extravagance underground. Careful daily sampling of stope-faces is needed to give intelligent direction to the extraction of ore today, as well as to furnish records for future guidance in mining ground temporarily left intact because below the economic limit. The hard truth must be learned that unprofitable ore cannot be made profitable by any legerdemain in the accountant's office; if the yield does not meet the working cost, much less will it carry the various expenses incidental to a big business. Emphasis is laid on the fact that the expenses at the London office, the extras at Johannesburg, the interest on borrowed capital, the retainer of the solicitor just as much as the wages of the miner, the fees of the director just as much as the pay of the driller, are all part of the cost to be debited against the gold extracted, and unless the ore is rich enough to meet all these expenditures it is best left where it was deposited by Nature.

Hitherto the idea has been to get ore in sufficient quantity to supply a mill of given capacity, and all the work of the mine has been shaped so as to yield the tonnage adequate to meet the consumption of the hungry batteries. To work a part of the mill only and to permit the rest of it to remain idle, was thought unspeakable. That meant an acknowledgment of failure. It entailed an increase in the cost per ton and the spoiling of the manager's record as an economical superintendent. Now comes our iconoclast, Mr. Marriott, and says: "Run your mill to suit your mine, and not, as hitherto, your mine to suit your mill." Shut down a part of the mill rather than handle ore that is below grade and therefore unprofitable; cease to worry about meaningless records of economy and keep in mind the one fact that ore is either profitable or unprofitable; leave the latter to extract the former; if the amount available is insufficient to supply the mill then operate with fewer stamps; in other words, face the facts, and discard make-believe.

Thus the proposed change is in the interest of economic truth; it is hoped that it will save the time of secretaries and conserve the energy of managers. It will teach the public not to compare mines on the Rand with those elsewhere, or even one mine on the Main Reef with its neighbours, but to understand the development of the same mine at successive stages. The method will be tried in the next quarter, that beginning in June: for it is too late to introduce so radical a change in the March quarter. The result is awaited with keen interest.

Profitable Ore.

We learn, not with surprise, that the thoughtful technical men on the Rand are favourable to the standardization of technical terms. They have plenty of scope for reform, the zeal for which is effective when tempered by intelligence and controlled by common sense. At the present moment a new policy is being introduced into the operation of the great mines of the Transvaal and in elucidating that policy it becomes necessary to employ terms generally in vogue. Two of these may be instanced; others might be quoted, but a multiplicity would hamper discussion. We refer therefore more particularly to 'payable' and 'ore.' The first of these is bad English; ore does not 'pay,' save in a colloquial sense; what is meant is that the ore is 'profitable.' Why not say so? A thing is 'payable' when it is unpaid and due, or when it is capable of being discharged by payment; it becomes 'profitable' when producing or resulting in profit. But there is more than pedantry between 'payable' and 'profitable.' An ore that 'pays,' that is, meets the expenses of exploitation, does not necessarily yield a profit. Material that contains 18 shillings worth of gold per ton under conditions permitting the extraction of the gold at a total cost of 18 shillings per ton is 'payable,' and is best left in the mine until some more auspicious day when it can be worried out of the earth in a remunerative fashion; but the banket that contains 20 shillings in gold per ton is, under the same conditions, a 'profitable' material. 'Payable' is an untranslatable vulgarism betokening inaccurate notions of mining economics. We also have 'ore,' 'low-grade ore,' and 'waste.' The middle term is mis-applied. Rock containing sufficient metal to be profitably exploited is 'ore': rock not containing sufficient metal to meet all the expense incidental to its breaking, removal, and treatment is 'waste.' Where the total cost of exploitation is 18 shillings per ton, the metal-bearing rock that yields 16 shillings is not 'low-grade ore,' it is 'waste.' Stuff yielding 20 shillings, under the conditions specified, is 'low-grade' ore, and ore valued at 30 or 40 shillings per ton is, under the same conditions, 'high-grade' ore. Unless it can yield a profit the mine-product is not 'ore' and it is misleading to call it such, even if preceded by an apologetic adjective.

The habit of talking of unprofitable material as 'low-grade ore' is the outcome of the practice whereby waste is mined in order to so increase the tonnage as to create a fictitiously low cost per ton. If the managers on the Rand would recognize the fact that it may be as profitable to mine 'waste' as 'low-grade ore' they would escape some of the fallacies now so vigorously attacked by Mr. Marriott. When the average cost is 18 shillings per ton and a layer of banket assays 16 shillings per ton, it may be more economical to stope in barren quartzite than to break material just below grade, because the removal of 16-shilling stuff unprofitably depletes a future source of ore-supply, the supposition being that the day will come when costs will have been so diminished as to render such material a source of profit: if mined now, the loss is 2 shillings per ton. Obviously the removal of 'waste' leaves less chance for a misunderstanding and invites investigation at the earliest moment. In any case it does not entail the confusion of thought incidental to the exploitation of material the low content of which places it near the border line separating 'ore' from 'waste.' Owing to a lack of clear definitions, it is a common failing to break ore just below grade in order to reduce the average cost; those in charge blinding themselves to the fact that every ton below grade robs so much of the profit to be derived from 'ore.'

Rhodesian Reports.

Criticism has been offered by the daily Press in regard to the method of issue adopted by the Consolidated Gold Fields of South Africa in the flotation of its latest subsidiary, the Shamva Mines. An equally important feature relates to the publication of technical data concerning the value of the ore in the mine. This information is not likely to be intelligible to the public at large, for it is not intelligible to technical men. To begin, we deem it fair to criticize Mr. H. A. Piper, an honoured member of the Institution of Mining & Metallurgy, for using the phrase 'ore in sight.' This, by the explicit recommendation of the Institution, is taboo, for excellent reasons into which it is not necessary to go. Next we come to the description of assay-results; these are stated variously as "reduced" and "unreduced." The estimate is expressed as follows: "Probable tonnage, 527,340 tons unreduced assays value 7·89 dwts. per ton, sterling value £873,000, reducing high assay value, same tonnage valued at 4·85 dwts., sterling value £536,000. In addition possible tonnage 293,000, unreduced value 8·95 dwts., reduced value 4·88 dwts., sterling value unreduced £550,000, reduced value £300,000." We can state that when submitted to two or three of the most experienced men in this City, the foregoing statements proved incomprehensible. We assume, as most likely, that the difference between the "reduced" and "unreduced" refers to the elimination of high assays, but the phraseology may warrant the interpretation that a factor of safety was introduced, cutting down the average by a fixed percentage. But if we and others versed in such matters are left in the dark, what chance is there that this report will convey the facts fairly and frankly to an untechnical shareholder? Moreover, while it is plain that 'probable' ore can be measured and sampled with sufficient accuracy to be stated in tons and pennyweights, we question whether 'possible' ore can be stated with such nicety as to permit its average value to be given in decimals of a pennyweight. 'Possible' ore cannot be sampled, for it is only accessible in part; why then this pseudo-accuracy?

Another recent South African prospectus is that covering the flotation of the Gold Schists of Rhodesia. In this prospectus, as published in the Press, no engineer's name is given as a guarantee for the accuracy of the technical data relating to the ore in the mine, its tonnage and value. At the end the name of Mr. Mennell is introduced in an incidental manner, but the basic facts concerning the mine are conveyed in bad English and by the medium of terms open to obvious criticism. However, the main point is that the name of the responsible engineer or engineers is not given. It cannot be made too clear that the statements of directors and other non-technical persons are of no value whatever, except in so far as they quote the information given to them by properly qualified engineers.

This brings us to the general subject of Rhodesian reports. It is not too much to say that most of them, as published by the mining companies, are open to the charge that they fail to give explicit information. When criticizing the wording of a cablegram sent recently from Salisbury, one of the officials interested told us that the wording did not matter. "What does the average shareholder understand about such things?" he said. We confess that the poor shareholder is not likely to be assisted in his natural and legitimate curiosity by officials who appear to assume that he is only a necessary evil. The fact is that secretaries and directors appear too frequently to go through the motions of giving information, careless whether they actually convey it or not; they conform with the letter of an unwritten law, but disregard the spirit. We quite agree that the publication of periodical reports and the transmission of news from the mine to the shareholders is waste of time and money unless the information is made intelligible to the recipient. At present such information arrives after outside speculators have got it, or it is conveyed in so cryptic a manner as to be useless. Some of the ambiguity and obscurity of the reports is due to carelessness, to disregard for the accurate use of technical terms, and to the adoption of a phraseology that is discreditable to men equipped with a scientific education. Such criticism may be unpalatable, but we believe most sincerely that the interest of the mining industry in general, and of Rhodesia in particular, calls for a proper recognition of the right of the shareholders to receive information promptly and explicitly. We ask for the support of professional men in impressing directors with this plain truth, for every effort to evade it tends to make the engineer a party to a game of unfair gambling and allies him with agencies that use mining merely as a means of extracting money from the unwary.

Amateur Technology.

Exploded fallacies and discarded methods come back to memory as we read some of the speeches of the amateurs who preside over the meetings of mining companies. Sir John Willoughy made a series of statements at the extraordinary general meeting of the Surprise Gold Mining Co., of which the least that can be said is that they were both extraordinary and surprising. This happened early in April, so that we do not write in a hurry but deliberately in order to lay stress on the vagaries that outcrop every time there is a flutter in Rhodesian mining. Sir John explained how the finding of ore below a fault and the evidence of a couple of short drifts was enough to warrant the confident assumption that the orebody would be nearly a mile long, this being the length of ore exposed above the fault. Moreover, he volunteered the cheerful estimate that if the ore maintained a stated average in width and value, then every additional 100 ft. in depth would yield half a million pounds worth of gold ; and in order further to encourage the exercise of the imagination he explained that " with modern appliances mining can be continued to a depth of at least 6000 ft., some contend to even 10,000 ft." Meanwhile we contend that such utterances on the part of a public man are dangerously misleading. It is thoroughly realized by those experienced in mining that man, in his search for gold, can penetrate deeper than orebodies persist. Sir John lays stress on the fact that the Surprise reef is "a true fissure, and therefore must continue down permanently in depth." No ore is 'permanent' that is, or can be, removed ; Sir John means 'persistent,' but his use of words is open to more than pedantic objection. The supposed superior merits of the 'true fissure' were exploded long ago and are scarcely worthy of exposure. As regards the delightfully simple calculations of possible ore-reserves, such arithmetical exercises remind one of the amateur poultry-farmer ; like many other weighty conclusions in this beautiful world they are hopelessly vitiated by the one weak link expressed by that little word 'if.' The Surprise mine has had a fine bit of luck and we hope that this luck will be followed by skilful management, but the facts of the case do not warrant the pseudo-technical heroics of the Chairman.

Oil Processes.

The rise in Murex shares, the patent litigation between the Elmore and Minerals Separation companies, the recent reconstruction of De Bavay's company, the success of the Sulphide Corporation, the development of the Potter process, and the lawsuit impending between the latter company and the Sulphide Corporation, all tend to attract attention to an interesting and highly scientific department of metallurgy. The four or five flotation processes, despite their rivalry and their conflicting claims, all seemingly depend upon one basic principle, namely, that of a selective action due to differences of surface tension, as exerted by means of the oleaginous covering imparted to metallic sulphides. It would appear as if any metallurgist that could have foreseen the development of this branch of wet-treatment processes might have patented the application of this one idea and thereby might have covered the entire field now shared by half a dozen modifications. Even now, in common with other friends of the various litigants, we may express regret that so much money is being expended in lawsuits between interests that ought to be consolidated; we can go further and say that it is a pity that a field of activity affording a reasonable profit to a few should be shared by so many. Obviously consolidation is imperative. If all the ores now subject to this special method of concentration were available to treatment by the four metallurgical companies, the profit of them would barely pay 5% per annum on the £1,250,000 of capital already involved; but it is obvious that should any of these kindred oil or grease processes succeed in a general invasion of the field now covered by ordinary wet concentration, then the scope for them would be enormously widened. Thus there is a wide margin between the existing position and the one remotely attainable. There is no question, however, that the imposition of a tax on metallurgical industry by the collection of royalty is always subject to opposition, which can be avoided in the interest of both parties to the transaction, by selling rights to use a process or a machine, or better, by the sale of the machine itself, accompanied in many cases by the design or erection of an entire plant. Another way of utilizing a process for the making of money is to purchase mines, the value of which can be quickly enhanced by proof of the ability of such a process to treat economically an ore hitherto deemed so refractory as to have no commercial value. Either of these methods is better than an inflated share valuation, as a means of extracting money from the public, or a scramble after royalties, as a means of taxing beneficiaries.

Advertising.

We note with interest that a majority of the members of the Institution of Civil Engineers voted against the amendment forbidding advertising. The subject arose through the submission recently of a regulation reading: "He shall not when in practice or intending to practise on his own account in any part of the British dominions advertise for professional employment." This was No. 7 of the proposals for the amendment of the by-laws under Section IV., referring to professional conduct. All the preceding six proposed regulations were carried by vote, but the seventh did not survive this test. Whatever was inherently commendable in the proposal was, it seems to us, already expressed under the fourth regulation, which says: "He shall not improperly solicit professional work, either directly or by an agent, nor shall he pay, by commission or otherwise, any person who may introduce clients to him." The result is satisfactory from every point of view. An attempt to lay down a law on a matter of taste—not conduct—was open to serious objection and involved complications highly regrettable. Of course, any "alleged professional misconduct by a corporate member" of the Institution of Civil Engineers can be "brought before the Council" and, if proved, may lead to expulsion. All that has happened is to differentiate once and for all between 'advertising' and 'misconduct.' As the senior engineering association in England, the example of the Civil Engineers is worthy of prominent record. It places advertising among the things that may be done, if done properly—a conclusion to which American, Canadian, and Australian engineers have arrived long ago. The times change, and we with them. When professional men lived in a village or a provincial town, in which each man was known on his merits, the effort to obtain undue prominence was deemed objectionable. A man's work spoke for him, and that was enough. But when professional men took the whole world for their field of employment, it became desirable and convenient that the name and address of engineers residing in distant localities should be readily available when required by friends or clients. The peculiarly nomadic character of the mining profession renders it necessary that means should be afforded whereby a man's whereabouts is accurately ascertainable. Hence the modified advertisement of a professional directory, in which the card giving the latest postal and telegraphic address of each individual affords an obvious convenience. To make public claim for peculiar skill or unusual experience, to offer to accept engagements for small fees, to pay commissions to persons instrumental in procuring such engagements, to hire publicity agents for the purpose of newspaper prominence — these and other lapses from decorum need scarcely be mentioned as examples of impropriety. The fact that such lapses can occasionally be recorded against engineers should not prejudice the employment of a convenience that has stood the test of a generation without injury to the repute of honourable men. Advertising is as much an instrument of industry as correspondence. Both can be used in an objectionable way; but both, within the limits of good taste, serve an obvious function. Old prejudices must go, slowly and decorously, if you will. They are retained longest by those who are least logical. The man who puts a brass sign as big as a tombstone on the front door of an office building or irradiates his window with gilt lettering visible at a hundred yards is exactly the poseur who inveighs against the 'un-English' tendency of advertising. Such inconsistency can only survive among those lacking in a sense of humour. It will not survive long, for the tissue of make-believe has been torn by the recent action of the Institution of Civil Engineers and by the accepted custom of English-speaking professional men in the overseas dominions.

Fossilized Methods.

Recently in the House of Commons a member drew attention to the lack of British enterprise in establishing agencies for the sale of our manufactures. Every consular report makes the same complaint; for instance, in Switzerland in 1908 only 61 commercial travellers represented British goods, while Germany sent 4711 and France 1531 *comis voyageurs.* Our consuls continually, but vainly, draw attention to the absurd custom still in vogue whereby British firms send circulars to foreign countries in English, using also the English measures, weights, and monetary units, all of which are antiquated, difficult to translate, and inevitably confusing. Even when seeking trade in Canada and other overseas dominions the British manufacturer appears to think his duty done when he has made a good article; for example, in Canada scale-rulers are used from right to left, but this apparently suggests no reason for changing a British product. No; the Canadian must adapt himself to the British custom of reading from left to right. The custom is allowed to antagonize the customer. Such stolid refusal to meet the demands of trade in other countries tends, of course, to kill business. It is not enough to manufacture an excellent article, it must be the kind of article for which there is a demand. And even then only the first step has been taken; it is necessary to convince the possible purchaser that you have just what he wants. Here the British system fails utterly. On every hand we hear that American firms are winning trade in Canada owing to the slowness and obstinacy of their British competitors. The American knows how to push the sale of his goods; the Britisher does not know, or, knowing, does not utilize his knowledge. The American puts even more energy into his selling than into his manufacturing, he is never in doubt as to the necessity for a vigorous campaign of advertising and a comprehensive system of agencies. The Britisher adopts a top-lofty attitude and announces that the excellence of his manufacture carries its own advertisement and that the merits of his work need no glib representative to emphasize them. Which is bunkum of an ancient type, and nothing more. Such archaic notions concerning advertising in some directions is curiously contrasted with the intensified employment of this method in other directions; for instance, the election of a member to Parliament is nothing more or less than a vigorous advertising campaign whereby the candidate shows himself to his constituents, talks to them, mixes with them, makes speeches to accentuate his particular fitness as a legislator, and brings to bear all the influence, political, industrial, social, and personal, likely to cause a given community to think well of him. It is nothing more or less than an advertising campaign. Another example is afforded by the book trade. No author, and certainly no publisher, expects to sell a book on its merits alone; how are those merits to be made known save by advertising? And it is advertised openly at so much per inch and surreptitiously by means of reading notices veiled as criticisms. The criticism appears only in the papers that carry the advertisement of the publisher, and it matters little whether the criticism be laudatory or condemnatory; but it is essential that frequent mention be made of the book so that curiosity be stirred and a demand created for it among people who take most of their ideas at second-hand. The success of a book depends upon advertising in some form or other. Of course, if a Gladstone will say in print that he sat up all night to read Conway's novel, that is better than a page in *The Times*, but it is an advertisement none the less, and the best of its kind. Other examples of helps to the sale of goods could be instanced, but they are usually not recognized on their merits. That is one of our British traits; humbug masquerades as good form, stupidity apes conservatism, mulishness poses as dignity. It is high time to talk less of tariff reform as a means for promoting trade and to recognize the utter neglect of the fundamental requirements of international business.

What is a 'Bank.'

The attention of the commercial world was once again drawn to the misuse of the word 'bank,' by a case before Mr. Justice Eve in the Court of Chancery last month. Here was a company with the high-sounding title of 'The National securities bank,' possessing a paid-up capital of £12, and formed for the express purpose of selling shares in a Cuban land company. Only a few months ago we had the egregious case of Feltham's Bank, the object of which was to attract deposits and subsequently to induce customers to purchase shares in other ventures of the promoter who posed as a 'banker.' The Judge, in trying the first-mentioned case, reiterated the view that the use of the word 'bank' should be limited and regulated by Act of Parliament. At the present time a 'bank' as such is under no obligation to the Government or to the public, differing in this way from an insurance company, which cannot commence operations without satisfying the Government as to its financial ability to meet claims.

It is not necessary to delve into the history of banking nor to describe the ramifications of modern practice. Both from a historical point of view and from the standpoint of present commercial requirements, a 'bank' is an institution that receives deposits from the public, and looks to a profit by lending its money at a rate of interest higher than that paid to the depositors. 'Bankers' may help their customers to secure investments, but they do not float companies and place the shares among their clientele. In practice the function of a 'bank' is clear enough and for that reason the Government authorities think it is unnecessary to interfere, but it is just because such time-honoured respectability clings to the word that thrifty folk with no great store of worldly wisdom are easily misled by the improper use of it. The Government authorities also point out that as a 'banker' is a trustee he can be indicted and punished if he fails, but we hold that prevention is better than cure.

In the days when the banking business was mostly in private hands, the method of employing the funds to profit was on an entirely different footing from the present. The introduction of the joint-stock principle into banking and the consolidation of institutions into an impersonal corporation has almost eliminated individual judgment on loans and has reduced everything to the safer level of full liquid security. In other countries the word 'bank' is used in a far wider sense, which we think is a mistake, and we hope that at no distant date some international conference may discuss the advisability of standardizing international methods. In France, for instance, a bank is often a financial house formed for the object of protecting the market for shares in companies belonging to the same group and for conducting investment business. In America, the banking laws give protection and privileges, making it advantageous for a financial firm to be described as both 'bankers' and 'brokers.' In the same way it is not uncommon for a wealthy American to form a local 'bank' which administers his fortune and loans his money, together with that of the depositors. In England and in the Transvaal we had for a few years the Barnato Bank and the Robinson Bank, both formed for the purpose of safeguarding subsidiary institutions, but neither of these institutions was fully understood by the public, which was rather mystified by the title. The fact that these two companies were eventually dissolved is not regretted just for this reason.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

JOHANNESBURG.

Central Rand Deep Levels.—Owing to the great mass of coincident meetings, many facts of importance announced at annual meetings escape the notice of general readers of the mining news. The publication of details concerning the City Deep has thus been viewed with little more attention than the statistics of production of some old mine. Quite apart from the bearing of the data on the prospects of the City Deep area, the figures are of general importance. At the meeting, R. W. Schumacher rightly claimed that the property promised to be one of the greatest gold mines of the world. The total tonnage developed on the Main Reef Leader is now estimated at 1,662,307 tons of 8·33 dwt., which is a value 1 to 2 dwt. above the average grade of the Rand today. The disclosures are said, in the consulting engineer's report, to be particularly encouraging for the reasons that (1) they cover an area, at an average depth of nearly 3000 ft., of great lateral extent, the 8th or connecting level, upon which 40% of the ore reserve is developed, being 7500 ft. long; (2) development results to date may be considered as throwing light favourably on a larger area of undeveloped ground, lying above, up to the northern boundary; (3) the Main Reef Leader is profitable on all levels, as shown by the following classification: 5th level, average value, 10·7 dwt.; 6th level, 8·3 dwt.; 7th level, 9·3 dwt.; 8th level, 8·3 dwt.; and 9th level, 7·1 dwt. [The distance between the 5th and 9th levels on the plane of the reef is 1050 ft.] (4) Close similarity of grade in the eastern and western portions of the mine, although the lateral extent is so great: the average value of ore at No. 1 shaft being 8 dwt. and at No. 2 shaft, 8·5 dwt. per ton. (5) A remarkable regularity of gold distribution throughout the area developed. Only 8·6% of the reserve is below 5 dwt. All these factors well support the hopeful view expressed concerning the City Deep as one of the world's great mines.

The Stope-Drill Competition, commenced a year ago, has been brought to a close and although the progress of the trials has been watched with flagging interest, the report of the committee will be a document of great value. I understand that the order of merit forecasted by me in your issue of February has proved correct with the difference that the Siskol and the Holman 2¼ in. drills, instead of being judged in this order of superiority have been bracketted winners. Both these drills are percussion machines, under 100 lb. in weight, that have averaged their 30 ft. per shift for a long period under normal working conditions.

Ore Reserves. — The references to the calculation of ore reserves, made by H. F. Marriott, in his address to mining men on the new form of quarterly mine returns, have led to much discussion among local surveyors. The contention advanced has raised many points that have been well debated in the collection of papers on 'The Sampling and Estimation of Ore in a Mine'; at the same time, there is anything but finality in the principles as accepted locally, and greater uniformity is desirable. The rigid rules laid down by Mr. Marriott are not generally considered to suit the requirements of this district, however applicable they may be to deposits of less persistence and regularity. Mr. Marriott's views were expressed as follows: "A system has been started since I left these fields of stating that a drive of itself develops a certain amount

Native labourers enjoying their Sunday rest.

of ore reserves in the reef standing above it. This is an entirely new principle to me and I hope that, with the system now before you, we have seen the last of it. A drive unconnected with other drives develops nothing but itself and the rock that is taken out of it. If this were not so, then what have you developed when you have put through the necessary winzes and raises?" It may be pointed out that it is almost universal practice on the Rand to consider ore to be developed by drifts, without winze and rise connections. The answer to the above question is, therefore, that no more ore is developed by the winzes and raises, but more light may be thrown on the value of the blocks by these workings in the same way that further knowledge is gained by stoping from winzes. Mr. Marriott takes as his definition of ore reserves on the Rand "all reef which is available for immediate stoping, without winzing or raising." The accepted interpretation is usually quite different; ore reserve figures appearing in the annual reports generally represent all reef that is opened up by drifts and that can be safely valued. The element of judgment is therefore strong. If the qualification of accessibility for stoping is enforced there there will still be a wide scope for latitude, as to whether faults encountered in the blocks are of sufficient magnitude to necessitate the putting through of more winzes and as to the length of ground to be considered developed beyond one winze where the point of establishing the next is doubtful. In many cases where blocks are large, the tonnage can be returned at a splendid value with far less security—though ready for stoping—than in the case of a strip of ground between two drifts, at moderate distance apart, unconnected by winzes. From the point of view of shareholders' reports it certainly seems that the best purpose is served by presenting a figure that represents, in the opinion of experts, the tonnage of known value above the drifts. The question of stope-faces is one of administrative concern, and should be beyond the sphere of anxious investors.

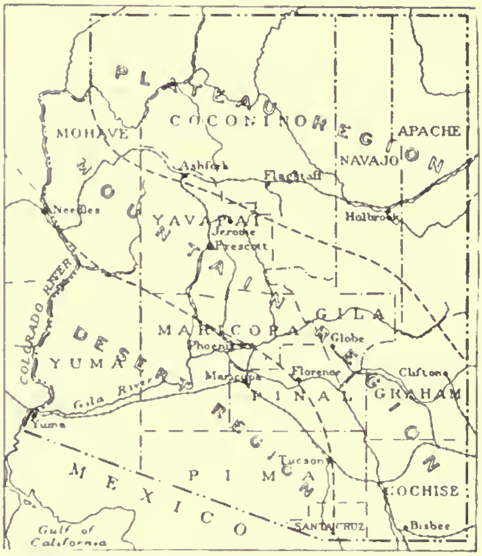
Rand Mines.—The annual meetings of the Rand Mines and the East Rand Proprietary companies were held on the same day (March 23) and provided ample food for thought to those anxious to rise above details. The two groups are of course of enormous importance, the former comprising the most representative of the moderate deep levels, and the latter, the first great combination of properties under one control. Working costs of the Rand Mines average 18s. 4d. per ton milled and the profit 12s. 9·7d., both a shilling or two above the local average. The influence of the Crown Mines upon the total and average results of the group is noteworthy, and the prospects of speedy improvement in the results of this subsidiary amalgamation are thus a matter for satisfaction to two groups of shareholders. The expectations of a Crown Mines dividend of 130% have been re-affirmed, and it is announced that development is to be pushed ahead so as to produce reserves of ten or eleven million tons by July 1912.

East Rand Proprietary.—At this meeting Sir George Farrar was vigorous in his praise of the "largest gold producer in the world" and its operating results. During 1909, 1,830,280 tons were milled for a total yield of £2,671,750 or 29s. 2d. per ton, of which £1,259,057 or 13s. 9d. per ton was working profit. This group of mines is now on a monthly crushing basis of 175,000 tons, which is to be increased to 200,000 tons.

State Mines.—The remarkable success of the public issue of 175,000 shares in the Government Gold Mining Areas (Modderfontein) Ltd. out of the total capital of 1,400,000 shares at £1, reflects two things; the gratification with which the public seize the opportunity of investing 'on the ground floor' in any Rand proposition, and the popularity of the Far East Rand in the region of the Modderfontein. Within a few days of the closure of applications, the shares rose from £1 to 37s. 6d. and have remained steady in the region of 35s. The allotments were so arranged that the applicant for 400 shares received 42 shares, while applicants for 40 shares and less received their amounts in full. The scrip is therefore widely distributed among small holders. In raising the market-value of the shares to 37s. 6d., the intrinsic worth of the mine has apparently been neglected. Calculations are made on the basis of 2,000,000 tons per annum, but such an assumption of milling capacity is as yet wholly unwarranted for this block of ground, in spite of its 2,000 claims. The experience of all the mines in this district has indicated that a crushing capacity of, say, 60,000 tons per month is the maximum that could at present be introduced, with production commencing five years hence. On this basis, the grade probability is about 25s., with 17s. costs, leaving 8s. profit, of which the shareholders would receive roughly 5s. per ton or £180,000 per annum distributable profit. This probable annuity, five years hence, only gives the shares a value of 25s. with justification for an increase when an augmentation of plant is prompted by development results. The working capital provided is not enough to allow the property to be split into two independent mines, as would be warranted by the claim-area.

SAN FRANCISCO.

Copper shares have suffered a decline more severe than any since the financial stress of two years ago. Several factors are responsible for this adverse movement of the market. The recent controversy between certain gentlemen prominent in the affairs of the Utah Copper and the Nevada Consolidated served to arouse suspicions as to the extraordinary reserves of ore claimed by both companies. The argument was inevitable that if great mines such as these, which had been examined and reported upon by eminent engineers, and which had been studied and scrutinized as few mining properties ever have been, still admitted of such differences of opinion concerning volume of ore and tenor of copper, what might be expected of other mines regarding which so much less was known? A decided improvement in the copper market would have gone far toward counterbalancing the unfavourable impression, but the weakness of demand was conspicuous long before the issuance of the report of the Copper Producers' Association for March. The consumption of copper should follow the demand for steel; the output of steel has been steadily growing, but copper has failed to respond. The public timidity toward copper stocks was accentuated by a report on the condition of the Granby mines in British Columbia, submitted by Otto Sussmann. The occasion of this examination was a change in management caused by the resignation of A. B. W. Hodges, who has gone to assume direction of the operations of the Cerro de Pasco Mining Co. in Peru. The president of the Granby company went with Mr. Sussmann to look over the property, which had been equipped with new plant. The result was a surprise to the company as well as to the public. Instead of the 20,000,000 tons of ore said to be available, according to the statement furnished to Stevens' Copper Handbook, or the 10,000,000 tons officially claimed in the company's circulars, the company now definately announces Mr. Sussmann's conclusion that the reserves do not exceed 6,000,000 tons. Thereupon the shares fell from 111¾ to 34, a collapse scarcely warranted even by so serious a confession of shrinkage in the ore reserves. The cost of copper produced at Granby was 10·4c. per lb. in the latter half of 1909, on which a net return of 13·14c. was realized. This episode may in the end have a salutary effect; it will emphasize the need for explicit detail statements, with maps, plans, and sections, and a full analysis of conditions such as few companies in North America have hitherto considered it necessary to furnish as a condition precedent to winning public confidence. Meanwhile Granby is not dead, nor likely to expire. At six million tons it has material for 12 years, on which a net profit of considerably more than $6,000,000 may be anticipated, and the possibilities of its 1100 acres of mineral-bearing ground have by no means been exhausted. In fact, as explored by drilling, these have never been fully determined. The British Columbia Copper Co. is proceeding to enlarge



Globe in Relation to Physiographic Regions of Arizona.
(After Ransome, U.S. Geol. Survey.)

two of its furnaces, and to provide railroad facilities for the Lone Star mine. It is fair to say that the tumble in copper stocks was general, even the Calumet & Hecla declining to 595, which is manifestly below its actual value. Amalgamated receded from 90¾ to 74, and others showed corresponding depreciation.

Phelps, Dodge & Co. has issued its annual report for 1909, announcing total sales of 185,033,415 lb. copper. The company has added to its strength during the year by the acquisition of the Burro Mountain copper mines, situated 12 miles from the Silver City branch of the Santa Fe railroad. The property consists of 56 mining claims, on which 2,000,000 tons of ore have already been developed, with larger quantities indicated. The Copper Queen mine produced a total of 595,623 tons yielding

84,429,791 lb. copper; the Detroit Copper Mining Co. milled 454,406 tons during the year, assaying 3·1% copper, making 69,134 tons of concentrate assaying 15·85%, or a total saving of 78%, the tailing assaying 0·8% copper. The Moctezuma, another of the Phelps-Dodge properties, with works at Nacozari, Mexico, milled 510,094 tons of ore, averaging 3·22% copper, yielding 110,725 tons of concentrate assaying 11·8% metal, the ratio of concentration being 4·6 to 1. The tailing assayed 0·584%, and the extraction was 85. Associated with these concerns is the Stag Cañon Fuel Co. at Dawson, New Mexico, which produced 1,087,768 tons of coal, of which 439,661 were sold to the railroads and 559,176 were coked. The latter represents the slack that was washed before coking. The clean coal charged into the ovens was 471,512 tons, producing 283,964 tons of coke, averaging 11·2% ash. Re-washing jigs have treated during the year 38,910 tons of material that would otherwise have been consigned to the waste dump. A rescue station equipped with Draeger helmets and other modern appliances for life-saving has been installed at a cost of $6620. In connection with the rescue station a technical library has been provided. Active development has been continued at all the mines; the Copper Queen reports 60,319 ft., the exploration, development, deadwork, and repairs constituting 31·31% of the total mining cost. The general manager, Walter Douglas, states that the exploration and development work was carried on at an average rate of 5000 ft. per month, or one foot to 10 tons of ore extracted. The company has also explored widely for new mines, but discouraging results attended such work at West Cananea, at Courtland, in the Huachuca and Winchester mountains. The Las Vegas mine in Chihuahua was also unwatered and examined, but its inaccessibility caused abandonment of negotiations. The purchase of the Burro Mountain mines, however, provides an ore reserve of great size and value, to be held until needed.

Cœur d'Alene.—Announcement of a settlement out of court between the Bunker Hill & Sullivan Co. and the Federal Mining and Smelting Co. was made late in April. Thus expensive litigation over the properties at Wardner, Idaho, will be avoided. The contest related to ownership of orebodies through the application of the American principle of the extralateral right attaching to mining claims. The attitude of the Bunker Hill & Sullivan was that the Federal company had nothing to lose by compromise and everything to gain by continuing the fight, while the Bunker Hill company had everything to lose and nothing to gain, except that to which it had always thought it had a good title. The Federal evidently shared this view, so that an accommodation of the dispute was made. The essentials of the proposal are: (1) all suits and counter-suits are to be dismissed; (2) the Federal company is to convey to the Bunker Hill all of the Wardner properties that it owns or controls between Government gulch and Elk creek, and is to assign to the Bunker Hill company all stock owned or controlled by it in companies whose mines are situated between these boundaries; (3) the Federal company reserves the right to work out its orebodies not in conflict with the Bunker Hill; (4) in consideration of the foregoing the Federal company receives 27,000 shares of stock in the Bunker Hill, the stock of the latter being increased to 327,000 shares of $10 each in order to provide this extra amount. This agreement has been reached by the presidents of the respective companies, their attorneys, and engineers. It is interesting to note that one feature of the arrangement is the adoption of vertical side-lines between adjacent claims. The voluntary abandonment of the extra-lateral right has become common in the adjustment of mining contests in this country.

Goldfield Consolidated lost its refinery and a portion of its big mill by fire on April 8. The fire started from an explosion in one of the refinery furnaces and was spread rapidly by the oil under air-pressure in the broken pipes. The refinery, ore-bins, belt-conveyor, sampling department, change room, and 10 stamps were burned before the fire was put out. The main part of the mill was saved and 80 of the 100 stamps could have resumed work at once if there had been any way to get ore into the mill. While only 10 stamps were burned, twice that number were put out of service, because 20 stamps are run by each motor. New building material and machinery have been ordered by telegraph and it is expected that within 60 days the undamaged part of the mill will be at work. The burned stamps will be replaced as promptly as possible. In the meantime the company has arranged to treat ore at the Belmont mill at Millers and may use the 90-ton mill of the Nevada-Goldfield Reduction Co. The concentrate will be shipped to the smelters until the refinery is re-built as will also some of the rich ore in the Clermont workings. The actual loss amounted to about $200,000, there being no insurance. The company has a surplus of more than $1,000,000 above that necessary to pay the next dividend. It is expected that returns from rich ore sent to the smelters will keep earning up to the usual rate. In March the gross value of the ore shipped amounted to $1,017,000. From this $950,000 was extracted with a net profit of $730,280. During the month 26,619 tons, averaging $38·20 were treated, the extraction averaging 93·5%. J. R. Finlay reported an increase of 60,000 tons in ore reserves for the month.

Zinc ore and the tariff continue to excite attention. It will be recalled that when the new tariff bill was being formed, the zinc-ore producers of the Joplin district requested a duty of $1\frac{1}{2}$c. per pound on the metal in imported ore. They pointed out that for many years spelter had been protected by a customs duty while ore-producers were exposed to competition from both Mexico and Canada. In recent years the zinc-smelters, in an effort to get away from the high prices paid for the clean concentrate produced at Joplin, had not only done much to stimulate production of zinc ore at Leadville and in other Western districts, but had begun to make regular shipments from across both the northern and southern borders. To the demand for a tariff on ore, they interposed the objection that the Joplin district was no longer able to produce the amount of ore needed by American furnaces.

Bisbee and the Copper Queen Mine, Arizona.

The Joplin district, including contiguous parts of Missouri, Kansas, Arkansas, and Oklahoma, produced 147,310 short tons of zinc ore in 1894. From this figure the output increased to 286,538 in 1907, dropping with lower prices to 258,628 in 1908. In the meantime, and particularly since 1904, production elsewhere in the United States grew rapidly though it was still small as compared with Joplin. This outside production is especially small if the higher content of the Missouri ore be taken into account. It was early determined that a tariff on zinc ore would be laid; and August 1, 1909, the new duties took effect. They are arranged on a sliding scale, the tax varying with the percentage of metal in the ore: up to and including 10%, the ore is free; from 15 to 20%, the tax is $\frac{1}{4}$c.; from 20 to 25%, $\frac{1}{2}$c.; over 25%, 1c. per pound of metal contained in the ore. Since no ore under 25% can be economically imported, the practical effect is to levy the maximum tax. This, on the ores actually imported, which assay about 36% zinc, amounts to $7·20 per ton. On this basis, making due allowance for freight-rate and difference in grade, Mexican ore is as cheap at the Kansas furnaces equipped to smelt it, as is the near-by Joplin ore. If the amount paid as duty be deducted from the price paid the Mexican miner, which is largely done, the foreign ore may be treated at higher profit than the domestic. That this is true is shown by the fact that foreign ore has continued to be imported, though in somewhat reduced amount. In the seven months of 1909 before the new law went into effect, importations averaged 10,538 tons per month. In the first seven months following, they averaged 7627. For January and February they were equivalent to a little more than 28% of the Joplin production. In this connection the following figures are of interest:

	Imports. Tons.	Value.	Joplin production. Tons.	Platteville production. Tons.	Joplin base price.	Spelter, New York price. c. per lb.
Seven months under old law....	73,771	$851,213	173,199	37,420	$40·21	5·097
Seven months under new law...	38,137	515,462	143,825	46,906	47·70	5·999

It is evident from this that (*a*) higher prices have not stimulated Joplin production enough to supply the increased demand ; (*b*) importations continue, but in less amount ; (*c*) production in minor American camps, yielding lower grade ores, has increased ; (*d*) the price paid by consumers of spelter has been much larger. Unfortunately detailed figures of production at Leadville, Park City, and in other districts where low grade zinc ore is produced as an incident to gold and silver mining are not available. It is known, however, that zinc mining throughout the West has experienced a marked revival. At Butte, options have been taken on a number of properties by experienced zinc producers, and much examination work is under way. The Empire Zinc Co., a branch of the New Jersey Zinc Co., has partly unwatered the Alice mine, and is having the stopes examined. The same interests are examining the Emma. The Butte & Superior and the Elm Orlu are already producing zinc ore and in Utah, Colorado, Arizona, New Mexico, and elsewhere the new demand for zinc ore is felt. All this shows one good effect of the new law ; ores that were formerly left unmined or wasted can now be marketed with profit. On the other hand the public pays more for everything into which zinc enters and the experience of seven months seems to indicate that the tariff is not high enough to give the Joplin miners the monopoly they anticipated. Joplin mines are prosperous none the less and since the tariff went into effect higher prices have been realized for ore than in any previous period of equal length. Apparently it would not be possible, even if the consent of the misty but important ' ultimate consumer ' could be won, to give Joplin a monopoly of the zinc market without putting the price of spelter up to such a figure as to invite importations.

LIMA.

Placers.—Much interest in gold mining properties has recently been displayed and it is quite likely that the extensive placer deposits, from which the Incas, and the races prior to them, obtained the precious metal, will soon be opened up. The placers of the province of Sandia have been worked in a desultory way during recent years. Lately the Franco-British-Peruvian Syndicate has had a large area examined, covering the properties of Aporoma and San Juan del Oro. The outcome of this inspection may be considered as favourable judging by the numerous ' denouncements ' of ground and water made in the name of the syndicate. Abundance of water is assured ; as the ' banks ' are high and adjacent to powerful streams, the question of sufficient dump-ground is not involved. The gold is stated to be evenly distributed, previous reports, on one of the properties, having indicated averages of 50 cents (U.S. currency) per cubic yard. The ground is well suited to hydraulicking. Perhaps the most serious matter is the transport of material once the Inca road from Tirapata is left. Although there are well beaten trails inside, these cannot be improved except at prohibitive cost. Further to the northward, in the Marcapata district, an examination of the placer ground was undertaken for American capital, but unusually heavy rains prevented a satisfactory investigation.

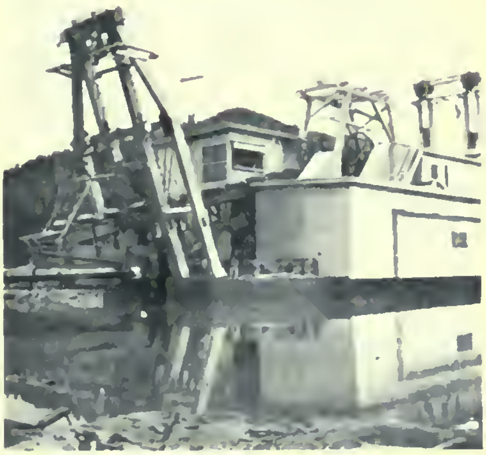
San Domingo.—In the same region is situated the San Domingo, a mine belonging to the Inca Mining Co., of Bradford, Pennsylvania. This has produced about £700,000 of bullion. The vein has been opened up extensively and has proved exceptionally rich in streaks on either wall, 'ribbon gold' being plentiful. The country rock is slate. A large tonnage of low-grade ore, 10 dwt. gold per ton, is said to be blocked out, as previous work was in the development and extraction of the high-grade streaks, which were treated in a 10-stamp mill and two Huntingtons, followed by concentration, roasting, pan-amalgamation, with cyanidation of the tailing. The presence of a small amount of stibnite suggested this scheme of treatment. No work has been done for the past six months, as the directors have been considering the erection of a modern plant, possibly 40 stamps, with accessories, as well as development work. The question of sale has also been before the board. A dump of 50,000 tons, said to average 10 dwt. per ton, would also be treated. A 600 h.p. hydro-electric plant is practicable, so that cheap power is available. The company has put much of its profits from the mine into building an extension of its wagon-road to the rubber lands controlled by its subsidiary, the Inca Rubber Co., and is developing them.

Rinconada.—Close to Pato, which is reached by branching off from the Inca Mining Co.'s road, the Rinconada Mining Co. (an American concern) has had poor success. The gold is said to occur in narrow streaks, in places exceptionally rich. Unfortunately considerable money was spent in erecting a 5-stamp mill, building a wagon-road, etc., while little attention was paid to developing the mine. Mismanagement, aside from the ordinary conditions to be solved in mining, has resulted in the company being heavily in debt to local people.

Before conditions were well understood a complete aerial tramway was delivered a Tirapata, the nearest railroad point; this error was followed up by an order for a traction engine 11 ft. between the fore wheels—a size totally unsuited to the bridges it would cross.

The old Montibello mine, in which some rich masses of gold ore were once exploited, is being worked again in hopes of encountering bonanzas similar to those of the past. The company formed in Lima has outgrown the original syndicate that first started operations two and a half years ago. Increasing attention will be paid to these southern goldfields, which have been curiously neglected.

Dredging is receiving a first trial on the Inambari river, where several years ago a dredge



A modern Dredge

was tried in the wrong place, that is, heavy bouldery ground. A subsequent attempt to float the dredge to more suitable ground resulted in it being sunk. The manager of the re-organized company, the Inambari Gold Dredging Concessions Ltd., of London, hopes to have the new 'boat' at work in July; it is expected to handle 1200 cu. yd. per day with a 5-ft. linked bucket-line. Wood will be used as fuel and the working cost has been estimated at 5½ pence per cu. yd., while the estimated yield of the gravel is placed at 7s. per yard. The bedrock where exposed appears to be slate; in places it is quite soft. The site of the present point of attack is about 164 miles northeast of Tirapata, a station on the Arequipa-Cuzco railroad. About 84 miles of the road is suitable for hauling material on two-wheeled carts (*arobas*, which were brought from Tunis and have apparently given satisfaction) in parcels up to 1400 lb. at a price of £1 per 100 lb. for the distance mentioned. The remainder of the journey is made by mule-back and human porterage, so that the cost for the entire route can easily reach £2 per 100 lb. or £40 per ton. The concession is said to be the most extensive of its kind that has ever been granted by the Peruvian government, for it covers 300 miles of the river, of which 50 have never been visited by 'white men,' with two miles of territory on either side of the main river and half a mile on either side of the tributaries. Ten per cent of the gross output goes to the Government.

TORONTO.

Coal in Ontario.—Some excitement was caused in mining circles during April by the reported discovery of coal in large quantities in northern Ontario. The mineral was found outcropping along the banks of the Metagami river on the Hudson Bay slope, some 60 miles north of the route of the Grand Trunk Pacific Railway. The usual rush of prospectors followed and about 20 square miles was taken up, one square mile being allowed for each claim, which does not include the right to other minerals than coal. The first reports indicated that the substance found was bituminous, but an examination of the samples forwarded to the Bureau of Mines showed the mineral to be undoubtedly lignite. The occurrence of lignite along the rivers of the Hudson Bay slope was known for many years, but the recent discoveries show the deposits to be much more extensive than was previously supposed. The lignite is of good quality and like that of the western provinces will be valuable as domestic fuel when the neighbourhood is settled, and possible as steam coal, but cannot be worked profitably for shipment to the markets of Southern Ontario owing to the expense of transport. Hopes are still entertained that bituminous coal may exist in this region, and the Temiskaming & Northern Ontario Railway Commission, believing that the lignite may turn into bituminous coal at depth, is sending a party to undertake exploration by pitting and diamond-drilling.

Cobalt.—The advent of cheap power to the Cobalt mines and mills has not as yet brought about the anticipated improvement either in the volume of shipments or the market for stocks. A slight upward movement, principally affecting the lower priced issues, has been followed by a reaction all along the line, and the market is now much depressed. The most noteworthy feature at present is the increase in concentration operations. The list of concentrating mills in active work or nearly ready to begin now numbers 13; in addition to these La Rose and the City of Cobalt have contracts with the custom mills for large quantities of low-grade ore. The low-grade being treated locally approximates about 1500 tons per day.

Shipments of ore for the first quarter of 1910 show a slight decrease as compared with the corresponding period of last year, being 6911 tons as against 7076 tons. However, 78,000 oz. of bullion was shipped during the quarter from the O'Brien and Buffalo mines, being the first important consignments of this sort from the camp. Ore shipments for the month of March showed a small increase, being 2606 tons as against 2546 in March 1909.

Ore Stealing.—The prosecution of the men indicted for stealing and selling Cobalt ore to refiners in Toronto has accomplished little or nothing except to show the inadequacy of the existing law for checking larceny underground. Two prisoners were acquitted and one was found guilty, whereupon the shrewd attorney for the defence raised the point that the laws forbidding the illegal sale of ore did not apply, as the sale was not completed until the ore had been refined, and therefore it was not a sale of 'ore' but of 'silver.' He asked that the case be referred to the Court of Appeal.

Chibougamou.—The Quebec government has undertaken the exploration of this district, believed to be rich in minerals, but distant from settlements or railways. Advance parties in charge of provisions and equipment have already set out. The main party, which will leave about the end of May, will be headed by three experts, A. E. Barlow of Montreal, J. C. Gwillim of Queen's College, and E. R. Faribault of the Canadian Geological Survey. Should the result of their observations show that much mineral wealth is in evidence, it is planned to open up the country by railroad construction.

Porcupine.—Much machinery was rushed into this district before the breaking of the winter roads rendered heavy transport impossible. The Scottish Ontario Gold Mining Co. has put in a hoist and boilers, and has 50 men at work. Peter McLaren, the manager, states that the showing in the shaft at 34 ft. is excellent. All the ore broken is being sent to the company's office at Glasgow to be tested. It is not proposed to build a stamp-mill until the company has 5000 tons of ore ready for treatment. Other companies that have got erected plants are the Monell Syndicate, Timmins, Crown Chartered, and Foley-O'Brien. The Wilson claims, eleven in number, and regarded as among the most valuable properties in the camp, are reported to have been sold to American purchasers for a large sum of money.

Gowganda is now shipping steadily, consignments up to date for this year amounting to 304 tons. The heaviest shipper is the Blackburn operated by the Millerett company, in the Miller Lake district, which has sent out so far 198 tons of high-grade and has on hand 4000 tons of low-grade ore, which it will not pay to ship owing to the long haul of 50 miles to the railway. The Boyd-Gordon recently shipped 30 tons. In the Bonsall, another Miller Lake mine, high-grade ore is being sacked on the 75 ft. level. The camp promises to do well this season, but it is badly handicapped for want of a railway. There is not much of an encouraging nature to note as regards the Elk Lake district, which has disappointed expectations. The Lucky Godfrey is a solitary shipper, having sent away 27 tons at the beginning of the month.

MELBOURNE.

Flotation.—The Amalgamated Zinc (De Bavay's) new mill at Broken Hill has started work. The plant is to comprise three sections, but so far only one unit is in use. This will treat 3000 tons of tailing per week and it is computed that an output of 1000 tons of zinc concentrate will be forthcoming regularly. The product to date ranges in composition from 48 to 49% zinc, so that a notable addition to the supplies of zinc ore for the smelter will be made when the company is producing weekly from the whole of its plant 2500 to 3000 tons of zinc concentrate. The idea at present is to set apart one of the units for the treatment of the tailing purchased from the Block 10 mine, as this has to be re-ground. The mill is so designed that everything can be done automatically. The idea also is that the material shall in its downward course be subjected to four separate flotations, thus ensuring the highest possible recovery. In connection with these flotation processes it is amusing to note the angling over the Potter process. First the company owning the process declined to treat with an offer by a rival company of £30,000 for its patent rights. Then the Potter shares fell. At once heavy buying took place, with the result that the word went round that another of the rival processes was nibbling at a controlling interest. Since then private negotiations have been started for a fusion of interests. This is not thought to be the Minerals Separation Co., with which the Potter company is in litigation. So the speculator has to toss up as between the Amalgamated Zinc and the Elmore companies.

It is announced that the Merton furnace used for the roasting of stannite at the Conrad mine in New South Wales has proved so successful that another furnace has been ordered. Both sulphur and arsenic are expelled, the arsenic being recovered in marketable form.

Nationalization of Coal. — The State coal mine of Victoria is interesting because it affords an example of the nationalization idea now so popular. Fully 600 men are now employed in the mine. A mine manager has been brought from New Zealand and 13 miles of railway have been laid to the mine. Before the idea fully developed in the heads of the Minister of Mines and the officers of his department, several leases had been pegged out at Powlett; as there was no means of getting the coal away, the ground was 'shepherded': finally, the holders were induced to take out three leases aggregating 3000 acres in return for surrendering certain areas to the Crown. Then came the Newcastle strike, the idea of nationalization, and the extension of the railway to the field. The decision of the Minister of Mines at the outset was to have no private enterprise at Powlett. He therefore reserved from public application 20 square miles of country. The only area held by others than the State was the 3000 acres mentioned. Apparently 20 square miles of country should be sufficient for the most avaricious land-grabber; but the little tract was intensely coveted, although forfeiture was impossible if the labour conditions were fulfilled. The owners were called upon to man the property. As there was no means of getting the coal away, they did not comply with the law. They also had to negotiate for capital and unfortunately for themselves did not go at it in the right way. Eventually a couple of small shafts were sunk, some boring was done to prove the seam at shallow depths, and an entry was started to open up the coal from the surface. All this time no means of transport was available. The Minister of Mines served notice that the labour conditions must be fulfilled. To add to the leaseholders' plight, an application was made by other private parties for the forfeiture of the claim to them on the ground of non-compliance with the labour conditions.

THE TOWN OF PORCUPINE, ONTARIO.

The next step was for the Minister of Mines to call upon the lessees to show cause why the leases should not be forfeited. The leaseholders had to attend upon him, instead of the matter being allowed to go to the Warden, and then the lease into which the coal dipped was forfeited to the State. "Why, it contains 1,000,000 tons of coal," said one of the parties to the Minister: "More like 3,000,000 tons," he rejoined. "Anyway if you don't put men on the other leases you'll lose them too." So despite the fact that there was no means of transport, the Minister of Mines appropriated the lease for the State. Such a proceeding is without parallel in Victoria, and if people were not obsessed with socialism the grabbing of property in this way would never be tolerated. No one could blame the Minister for forfeiting the lease and giving it to the other people who had applied for it. That has always been the practice. A lessee can hold land by simply paying the rent until some one else presents himself as an applicant for the area. He then must work or quit. The State never interferes. But in this instance the State has done a substantial piece of grabbing.

Not content with having appropriated unto itself and having barred private enterprise within 20 square miles of country, the Cabinet now enunciates the principle that the State will not permit a privately owned coal mine in Victoria. The reason given is that troubles with labour, such as have occurred at Newcastle, must not be repeated. This is too thin. The other day in New Zealand the State mines were thrown idle because of a trifling difference of opinion with the employees. The plea advanced in support of this socialistic move will be that if the State holds railways it should own coal mines. But two evils cannot make two rights. It may be added that immense brown coal deposits exist in Victoria. These are so close to Melbourne that it is believed they will be of the utmost value not only for the generation of electricity by means of producer gas but for briquetting. These deposits have been virtually shepherded for years. Will the State Government grab them also?

Queensland.—The value of the mineral output of Queensland for 1909 was £3,656,564, or £187,923 less than in 1908. There has been little change in any special branch of mining except coal, in which a great increase has taken place as the result of the strike at Newcastle. The Minister of Mines of the State in dealing with a somewhat cheerless position asserts that it arises partly from the attraction afforded to capital in other directions due to the run of good seasons and to the exhaustion of richly oxidized ore. The chief producer in Queensland was Mt. Morgan, which, despite the stoppage due to the accident at the mine, produced over £1,000,000 of metals, distributed £200,000 in dividends and paid £800,000 in wages, taxes, etc. The output and value of the principal mineral products of the State for 1908 and 1909 were:

	1908		1909	
	Oz.	£	Oz.	£
Gold......	465,085	1,975,554	455,577	1,935,178
Silver	1,162,276	117,889	1,001,383	99,093
	Tons		Tons	
Coal......	696,332	244,922	756,577	270,726
Tin........	4,825	342,191	3,325	244,927
Copper...	14,698	882,901	14,494	853,196
Lead......	7,109	95,239	5,329	68,543

The total value of gold won in Queensland to the end of 1909 was £70,225,250: and of other minerals, £22,137,259. Dividends paid by mining companies during the year amounted to £442,428.

Deep Leads.—The closing of another large alluvial mine in Victoria is reported. This is the West Berry Consols on the famous Creswick channel. The property has been a mining stringer of the first order and it is only its association with the Berry leads that has kept a devoted band of call-payers at its back. The company has won £180,000 of gold, collected £70,000 in cash, and has only distributed about £2250 in dividends as the result of 15 years work. The end came suddenly. A rush of water swamped the mine, and as the company was making a loss and had little ground opened up, the directors determined to cease work once and for all.

MEXICO.

Gold output.—According to the official statistics for the year 1909, the gold output of Mexico again increased, amounting to 45,015,000 pesos as against the amount of 38,096,661 pesos in 1908. The output of silver amounted to 77,110,000, copper 20,283,000, lead 6,397,000, zinc 1,043,000, iron 1,200,000, coal 4,400,000, mineral oil 2,800,000 and of other minerals 2,052,158 pesos. A peso is equal to 50 cents U.S. or 24½ pence British.

This is the best showing ever made by Mexico and speaks well for its future development. The mineral deposits of the country are as yet only scratched. Large stretches of country, especially the western regions nearing the Pacific coast, are almost unexplored. The Southern Pacific railroad with its extensions, and the Kansas City, Mexico, & Orient railway extensions into these regions are doing much to render accessible these mineral provinces of Mexico. The States of Sonora, Chihuahua, and Durango are particularly attractive from their gold prospects, and present excellent scope for development companies. The southern part of Guerrero, in the extreme south, is also a goldfield full of promise.

One of the main reasons for the increase of gold production in Mexico is the rapid extension of cyanidation for the treatment of silver-gold ores, in which the predominant value is silver. The old processes applied for the extraction of the silver, such as the Patio, failed to extract the gold associated with the silver. The cyanide process, however, recovers practically all this gold, hence the increase in gold production during the last few years. In 1890 the gold production amounted to only 2,000,000 pesos, in 1896 it had increased to 10,000,000 ; in 1903 it exceeded 20,000,000, and since then it has increased to the above-mentioned figure of 44,015,000 pesos.

The Carmen Mines of El Oro.—This company, which was recently re-organized with the Pleyades property, is developing an old mine situated upon the southern continuation of the San Rafael vein, worked in the Mexico, Esperanza, and El Oro mines, and immediately adjoining the latter property. When operations upon the Carmen mine were previously suspended in 1904, the work had been continued down to the 6th and 7th levels only, the latter at 865 ft.; and the small amount of exploration showed an assay-value of only $2 per ton, but in a good strong vein 15 ft. wide. This poor zone, which at about the same depth was also encountered in the adjoining El Oro and Esperanza properties, is now being penetrated in the hope of finding an enrichment at depth. The old shaft has been renovated and timbered to a depth of 865 ft., the hoisting and other machinery repaired, new electric pumps installed, and a new head-frame erected. Sinking was started early in April and is progressing at about 18 ft. per week. It is intended to sink to a depth of 1200 ft. before cross-cutting to the vein. Judging by analogy with the adjoining properties there is a good chance of success.

NEW YORK.

Bearish sentiment still rules in the stock markets. The chief factor in the making of the gloomy atmosphere of Wall Street is the recent upset suffered by the Republican party at the by-elections held in Massachusetts and New York for representatives to Congress. Democratic candidates were chosen by large majorities. The financial interests of the country regard the results of these elections as indicating that the Congress to be elected in November of this year will be controlled by the low-tariff wing of the Democratic party, and that agitation against business, and especially against corporation business, will be continued for the next two years. Other depressing factors are late reports of damage to the crops due to killing frosts in the West and South, where winter wheat and cotton are said to have suffered severely, the increasing exports of gold to Europe, and the gradual slowing down of business. As against these influences is the disposition of labour and capital to settle their disputes, and the appointing by President Taft of Charles E. Hughes to the Supreme Court of the United States.

Copper metal is weak, with production still running ahead of consumption. The Copper Producers Association, organized only a short time ago, may discontinue the publication of its usual monthly report on production, consumption, and supply. Several of the principal members of the association argue that this report furnishes too much ammunition for speculators in the stock markets. The discontinuance of the reports is regarded here as a confession that the copper position is weak. Anent the controversy regarding the ore reserves of the Granby, growing out of the recent report of Otto Sussmann, it is reported from the camp that Mr. Sussmann spent only a few hours in the mine, his report having been in the main prepared by an examination of the mine maps in the office of the company.

[This is the sort of gossip circulated whenever a damaging estimate of a mine is published. Mr. Sussmann is an engineer of high character and undoubted ability.—EDITOR.]

The report of the Utah Copper Co., recently issued, shows a production for 1909 of over 51,000,000 lb. copper with about 20,000 oz. gold and over 700,000 oz. silver. The average cost of making this copper was about 8½ cents per pound. The developed ore is estimated at 50,000,000 tons, with about 40,000,000 tons of additional probable ore. The Utah Copper coterie will evidently be the most important copper-producing group within the next few years. The same group controls Ray Consolidated, Gila Copper, and Chino. The first two are mines at Ray, Arizona, and the last named is situated in the southwestern corner of New Mexico. In Ray Consolidated, about 45,000,000 tons of better than 2% ore is indicated by the development work done on less than 120 acres of the company's large tract of mineral-bearing ground. On the Chino properties more than 10,000,000 tons of a somewhat higher grade are said to have been developed. The proved tonnage in the Gila group is about as large as the proved tonnage of the Chino, and the ore averages close to 2½%. The only one of these properties that is now productive is Utah Copper ; the others are being made ready for large production.

METAL MARKETS

COPPER.

Average prices of cash standard copper:

April 1910.	March 1910.	April 1909.
£57. 5s. 0d.	£59. 7s. 1d.	£57. 9s. 0d.

We have again to chronicle a severe decline in values during the month. Bull speculators have continued to close their commitments, having been made nervous by the serious relapses in American copper shares. The influence that the widespread and extensive purchase of the metal by consumers everywhere might have been expected to exercise on prices was swept aside by the dismay that followed the publication of the American Producers' figures for March. These latter, to the consternation of the whole trade, reported a further increase in production of 3282 tons over February and an increase in the stocks of no less than 7427 tons. The price of 3 months copper relapsed to £56, a fall of £3½ from the opening of the month. The final drop followed a report that the publication of the figures would be discontinued. On an official denial of this report being issued, prices recovered to £59. The improvement, however, was not held. Rumour had it that dissension has arisen among the producers and once again the price broke, assisted this time by the report of bad weather in the States followed by heavy damage to the young crops of corn and cotton. The less optimistic tone of the trade reports coming to hand from America was combined with an unsettled financial and political outlook. Copper shares were again adversely affected in the nervous liquidation that ensued. Copper metal gave way too, less severely however than might have been expected. Dealers who had sold refined copper to the trade covered in 'standard' on the open market and proved a welcome support at a critical time. The final price stood at £57, three months.

The outstanding feature has been the extensive purchases by consumers. While speculators have been selling on every advance, the trade has been buying on every relapse. The underlying trade conditions continue excellent, as they have been since the year opened, and good purchases have been made.

The American Copper Producers' figures for April show a decrease in the production of 1160 tons as compared with March, a decrease of 1836 tons in deliveries for home consumption and export, and an increase in the stocks of 8107 tons.

TIN.

Average prices of cash tin:

April 1910.	March 1910.	April 1909.
£149. 19s. 3d.	£147. 4s. 11d.	£133. 8s. 3d.

Tin has been controlled by the bull party, who appeared, early in the month, to have the command of the supply of cash warrants. The month opened actively with a substantial recovery to £154, three months, upon heavy bear covering on a poorly supplied market, but at this level holders sold, and with a drop in prices others who felt they had missed their market pressed sales down to £151. At this level the leading bulls supported prices again and induced a rise of about 30s., when the Eastern houses withdrew, having exhausted their supply. Any sustained rise has been rendered impossible, however, by the relapse in copper, and by the official publication of the Banca production showing an increase for 1909–'10. The market has been almost entirely professional and the nature of the transactions is shown by the fact that the contango at one time was as low as 10s., but widened to 25s. on the release of a line of warrants. The public holds aloof owing to the divergent opinions of the leading authorities as to the future of the market.

LEAD.

Average prices of soft foreign lead:

April 1910.	March 1910.	April 1909.
£12. 13s. 9d.	£13. 2s. 8d.	£13. 7s. 10d.

Lead has been lifeless, with a declining tendency. Demand has not been up to expectations and the arrivals in London, though smaller than for some time past, have been quite sufficient to keep the trade supplied. Buyers appear to be living from hand to mouth and to be quite indifferent about laying in stocks.

SPELTER.

Average prices of spelter:

April 1910.	March 1910.	April 1909.
£22. 9s. 10d.	£23. 0s. 7d.	£21. 10s. 1d.

The galvanized iron trade has again grown dull and there is little enquiry for spelter. Stocks at consumers' works are being allowed to run down, and little inclination is shown to replenish them on any large scale. Prices at the end of the month show a decline of about £1 from those at the beginning. An attempt to encourage purchases was made by the syndicate reducing its price and then raising it again, but the trade is not prepared to buy just now and a lower level seems inevitable.

PERSONAL

G. B. ADENEY has recently returned from Siam.

A. W. ALLEN is in Chihuahua, Mexico.

F. W. BAKER has resigned as chairman of the London Venture Corporation and is now managing director for the Hirsch Syndicate, with offices in Salisbury House.

H. B. BATEMAN has gone to Northern Nigeria.

F. K. BORROW has joined the staff of Pellew-Harvey & Co.

FRANCIS P. BRAY has been appointed superintendent to the West African Trust, on the Gold Coast.

HENRY BRELICH has returned from Rumania, and will go forthwith to the Caucasus.

F. A. BRISTOL, of the staff of the Consolidated Gold Fields, is temporarily retiring from active work in order to recuperate his health.

D. W. BRUNTON was recently injured in an automobile accident, but is recovering satisfactorily.

T. LANE CARTER, recently in South Africa and Central America, has joined S. W. Osgood, under the name of Osgood, Carter & Co., with offices in the First National Bank building, Chicago.

WILLIAM L. COBB, of San Francisco, is in London, returning from a holiday in Italy and elsewhere.

F. W. DENTON has been in Johns Hopkins hospital at Baltimore since January but is happily recovering.

T. DRAPER, on his return from Brazil, has opened an office at 39 Salisbury House.

HOWARD W. DUBOIS is at Cariboo, British Columbia.

HORACE H. EMRICH has gone to Kyshtim, Russia.

W. F. FERRIER has resigned as geologist to the U. S. Smelting, Refining, and Mining Company.

W. F. GRACE is in charge of the Waihi Grand Junction mine in New Zealand.

HERBERT HAAS is in Arizona.

EDWARD HALSE has gone to the Caucasus.

HENRY HAY is now in West Africa.

GEORGE T. HOLLOWAY has changed his address from Chancery Lane to 9 Emmett Street, Limehouse, London, E.

W. L. HONNOLD has arrived from Johannesburg. He will spend the rest of the year in Europe.

H. C. HOOVER has moved his office to No. 1 London Wall Buildings.

CARADOCK JAMES is here from Kalgoorlie.

H. K. MASTERS, on his return from Chile, is in London.

COURTENAY DE KALB was recently at Bisbee, Arizona.

J. T. MARRINER has returned from Singapore, after a visit to both Western Australia and South Africa.

E. D. McDERMOTT has accepted an appointment on the staff of the Kyshtim copper mines, in Russia.

W. W. MEIN is expected from Johannesburg.

HORACE G. NICHOLS returned from South Africa on May 7.

CYRIL E. PARSONS is about to go to Rhodesia.

H. A. PIPER has returned to London from Rhodesia.

BEN S. REVETT is on his way to Choco, in Colombia.

LESLIE SIMSON has resigned his position as engineer with the Consolidated Gold Fields and is returning to America. He is succeeded by C. D. LESLIE.

WALTER J. STANFORD left on May 6 to take charge of the Kluchi gold mines in Eastern Siberia.

GEORGE A. TWEEDY is here from Los Angeles, California.

D'ARCY WEATHERBE has resigned his appointment with the Rio Tinto Co., to become managing engineer for the Orsk Goldfields Co. in Eastern Siberia.

HARRY H. WEBB is in Rhodesia.

OLIVER WETHERED has moved to Capel House, 54 New Broad Street, E.C.

W. FISCHER WILKINSON has been appointed Principal of the consolidated Schools of Metalliferous Mining in Cornwall.

E. R. WOAKES has resigned as manager for the Linares Lead Mining Co., and has joined the staff of John Taylor & Sons in London.

GEORGE J. YOUNG, professor of mining and metallurgy in the University of Nevada, has been making a tour of the European mining districts.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Dredging for Gold.

The Editor:

Sir—Having been abroad for some time, and having only recently returned, I have just had an opportunity of going through the very interesting articles, under the above heading, appearing in your January and February issues; and upon these I should like to make a few comments, from my standpoint as a builder of dredges for gold mining.

First of all let me admit my sympathy with the majority of the arguments set forth in the editorial article of your January issue, for, although Mr. Cutten is, in my opinion, undoubtedly right in some of his criticism of the American type of dredges, I agree with you when you say that comparisons of working costs are of little value so long as they are based upon results obtained under widely different circumstances. A fair comparison between the American and the European type of dredge is possible only when both designs have had a competitive test in the same ground and under similar working conditions. Therefore do I say, whilst much that has appeared in your January issue has my sympathy, I do not agree with many of Mr. Purington's arguments, which are so strongly in favour of the American type as to suggest that the writer's patriotic feeling has not left him quite unprejudiced.

Mr. Purington rather strongly emphasizes the fact that all important American dredge-building firms can point to successful dredges of their manufacture, but the same may be said of New Zealand, where surely also a number of dredges of far lighter design have given the most satisfactory results; therefore, at any rate, in this statement of Mr. Purington's there is nothing to prove the superiority of the American type over that of New Zealand.

Against the undeniable success of the California dredges (when working in the North American continent), we have, I think, to reckon with the fact, adduced by Mr. Purington himself, that, as a rule, all attempts to install American dredges in other countries have been failures. Does not this rather suggest that a good deal of the success of the Californian dredges is probably due to other factors of vital importance, factors that have nothing whatever to do with the type of the dredges?

I think it is a great mistake—and unfortunately one of common occurrence—that builders are held responsible for the dredges when they turn out to be failures; for I maintain that, in the majority of cases, they are blamed quite undeservedly. The general failure of American dredges abroad has been, and is, owing, according to Mr. Purington, to bad management, or lack of money, or both. I think that European builders can fairly claim that the same reasons apply to a great percentage of dredges of our manufacture and further, we have but too often had to suffer from other causes, which are certainly no less serious. Many a dredge has been put on a property stated to contain profitable ground, and has turned out to be a failure because the whole business has been nothing more nor less than a swindle. Should the builder of the dredge be blamed for this?

In addition to these most serious circumstances, which certainly are not found in California, there is, further, the labour question. I do not think I am mistaken when I say that in this latter respect California is highly favoured over other countries, such as the Gold Coast, Siberia, and Tierra del Fuego, where, owing to climatic and other conditions, it has been impossible, until quite recently, to send out any other but a quite inferior class of men for any length of service.

Another point in which American builders have a decided advantage over their competitors on this side, is emphasized in Mr. Purington's remark that, largely within the last five years, the builders have developed their dredges assisted by conferences with the owners and operators. The great benefit they must have derived from such valuable assistance is obvious, and in this direction circumstances are, again, against European builders. American owners, I have been told, are, as a general rule, personally acquainted with the conditions to be complied with by their plant, and are equally conversant with their work; but how many of the men who direct the numerous gold-dredging companies controlled by European capital have ever even seen a dredge at work?

Notwithstanding this absence of useful information, which I can only characterize as a most serious drawback, we are frequently called upon to build dredges to a specification provided by clients who place their interests in the hands of a consulting engineer who has in many cases never seen the property; if the dredge proves to be a success, the consulting engineer gets all the praise, whereas the builder gets the blame when it turns out to be a failure. Often, too, the consulting engineer is, for reasons of financial stringency, obliged to keep within far too strict limits; and equally numerous also are cases where clients, for financial reasons again, simply order a dredge of a current light design to work ground so heavy that, had the builders known the real facts, they would certainly have recommended a much stronger design and construction.

It is, however, encouraging to see that, recently, there is a decided tendency in favour of consultation with the builder, and to acquaint him thoroughly with the circumstances under which the dredge has to work, and it may be expected that, in consequence, this particular advantage which our American competitors at present have over us, will disappear.

All these are important factors in the success of a dredge, but they have nothing to do with the question whether the Californian type of dredge is preferable to the European; which brings me to the point that Mr. Purington has still to justify his prophecy that dredges of the Californian type will, under all circumstances, prove either superior, or at least equal, to those of the European type.

I venture to mention the following fact: The dredge supplied by the Putiloff works for the Polyakof Platinum Co., pays, says Mr. Purington, a small profit. Against this stands the instance of the two dredges my firm supplied, nine years ago, for the properties of Count Schuwalow's successors, which pay a handsome profit, although they are just as obsolete in comparison with the dredges my firm is now building as are the Polyakof dredges in comparison with the modern Californian dredge. This comparison intensifies the difficulty of solving the problem as to the supremacy of the one type over the other.

I venture to suggest the chief cause of the wide divergence between Mr. Purington's opinion and my own lies in his contention that ground which can profitably be dredged for gold does not vary greatly, from a certain physical type, in any part of the world. Although readily admitting Mr. Purington's wide experience in mining matters, I do not hesitate to say that I hold in this respect a totally different opinion, for in my, perhaps more limited, experience, I have had plenty of evidence to the contrary. Nor in this opinion do I stand alone, for your own reference to the Burma dredge is indeed a strong argument in my favour. Experience has taught me that in many instances the usual type of dredge has been too light for the ground to be worked, but between this admission and the suggestion that a large heavy dredge is the only machine to be applied under all circumstances, there lies a wide difference. Just as no engineer would build a bridge for a light portable railway of as heavy a design as he would construct one for an ordinary heavy line, so I think it would be inadvisable to use the Californian type of dredge, with a considerable unnecessary weight in it, in a ground which is not 'cemented,' as it usually is in California, but just ordinary auriferous gravel.

In other words, to paraphrase Mr. Purington's metaphor, I readily admit the installation of light dredges has, in many cases, proved to be just as contrary to all economical principles as it would be to attempt to use a tack-hammer to drive a spike, but on the other hand, I am of opinion that the universal adoption of the Californian type of dredge would be just as clumsy a method of working as to use a big sledge-hammer to drive a tack.

P. GOEDKOOP.

Haarlem, Holland, April 2.

Mining in Siberia.

The Editor:

Sir—May I be allowed to make a few comments upon your editorial on this subject appearing in the March issue?

My experience has been that the Russian district engineers, when treated tactfully, will do everything in their power to help things along; but quite the reverse if a stranger tries to ignore them. Unfortunately, the average Britisher or American, when in a foreign country, usually starts with the idea that he is going to show the natives how to do things generally, oblivious of the fact that the natives may have feelings; consequently there is a good chance of trouble with any one of them who has authority.

As regards the mine provision stores, it must be remembered that the large majority of mines in Siberia are situated at considerable distances from towns, hence there is no other place where the men can obtain their provisions, and it is against possible 'squeezing' on the part of owners or companies that the Government engineer is authorized to control prices. Here I may say, that, at the mines with which I have been connected the stores have not been run at a loss—very far from it.

As regards the management of the Lena Goldfields, the English company has not purchased the mines, but bought the majority of the shares in an existing Russian company. A change in the method of management, even if desirable may, or may not, be practicable or possible at the moment; but surely that is not going to deter an English company from going into a business that yields £400,000 profit per annum.

A word on the question of the management of mines according to Russian law: It is true that the man actually in charge of works must have a Russian certificate; but a foreigner, or foreign company registered in Russia, may own mines, and such person or company may empower anyone to manage his or its affairs by power of attorney. This is the position of any manager sent out by an English company to manage its property. The manager represents the company, and, as a sop to the Russian law, engages a local man with a certificate, and probably gives him a foreman's job, taking from such foreman a note to the effect that he is responsible for the safety of the workings of which he is in charge. As regards the much discussed question of timbering, I think it will be found that upon investigation of the law, most difficulties dissolve into thin air. I have never heard of a district engineer closing any works, except for gross neglect of ordinary precautions. A district engineer closing works without sufficient justification places himself in a serious position, as an appeal to the head engineer of the Province, or, higher still, the Court of Mines, would undoubtedly rescind such a decision. I have driven levels in good standing ground without putting in a stick of timber (in one instance some 250 ft.), and shown the work to the engineer, in a district where no such thing had been done before. I need hardly say that I was quite within the law. Both in Russia and Siberia, I have always timbered both shafts and levels by the ordinary accepted methods. Russian district engineers are no fools, and do not wish to put themselves in a ridiculous position.

As regards the Volnarlarsky concession, without knowing the facts of the case, it seems to me purely a question of law. Either the Russian concessionaire should have handed over the title-deeds to the lessee, in which case the *ispravnik* or anyone else would have been powerless; or a clause should have been inserted in the contract compelling the concessionaire to purchase the gold obtained at a fixed rate (in this case, the market value). It is astounding that anyone should start work and spend money, without being absolutely sure of his position, or of the legality of his agreements. Would anyone do so in America, New Zealand, or England? Of course not; then why in Siberia? If a man does not know the law of a country he should do one of two things; either, find it out for himself, or obtain a reliable agent who does know it. If he neglects to fulfil the requirements of the law, be it in Russia or elsewhere, I do not see that he has anyone but himself to blame. In England, or America, we anticipate the possibility of being duped, and consequently provide against such a contingency; why, therefore, should the average Britisher display this naive confidence in human character in Russia or Siberia? To be successful in any other part of the world an ordinary working knowledge of the conditions and regulations must be acquired. Any English company operating on a large scale should have a competent Russian agent, whose duty it is to see that all applications and appeals to the courts, Treasury, Governor, etc., be lodged in order, and further, are attended to. He should keep in touch with the general manager on all questions having a legal issue, such as forestry laws, compensations to injured workmen, presentation of Government books, taxes, etc.; and last, but not least, should help the manager to 'get round' all possibly inconvenient regulations relating to the works, as in most cases is perfectly feasible.

I have had seven years practical experience in mining in Russia and Siberia, and should like to say that I have always received the utmost courtesy and help from the Russian mining officials.

R. FARINA.

London, April 10.

The Editor:

Sir—In your March issue I read with interest the editorial on Siberian mining. Your remarks are illuminating and, in the main, correct. Siberian mining companies have now been before the public, more or less prominently, for the last five years. So far the returns to the shareholders are a negligible quantity. It may be pertinent to ask, why?

Siberia is admittedly one of the greatest storehouses of ungarnered products in the world today. Those of us who have lived there, who have examined and exploited its mineral deposits, can well attest the possibilities. Not only in mining, but in agriculture, cattle, lumber, fisheries, this vast country of $6\frac{3}{4}$ million square miles is full of promise. In mining there is both placer and lode mining for gold, alluvial deposits of platinum, extensive coal and iron beds, and in the baser metals, especially of copper and lead, numerous and extensive deposits of the first rank.

There is nothing wrong with the deposits. There is nothing that cannot be cured, or endured, pertaining to environment, or natural conditions. There is, however, something radically wrong with enforced conditions pertaining to the regulation and operation of mines in Siberia. That is where the trouble is. For instance, Mr. Editor, as you remark, no officer of any corporation, other than a Russian subject, has official standing. There may be as many foreign officials as passports, but all are without standing in departmental eyes, and lack responsible power, according to existing regulations.

Wages are comparatively low, yet the aggregate expense is high. As Mr. Purington remarks in a current article, foreign mining companies have to carry the entire community. The building of hospitals, schools, and baths, although desirable, is still, when compulsory, quite a strain on the finances of a struggling enterprise. There are other and wider calls that sap the energy and drain the treasury. It is ominous that all foreign corporations operating in Siberia maintain silence regarding working costs; even the officials are, in most cases, prohibited from supplying such data, for which the mining world is waiting, and to which investors are entitled.

It were easy to instance past failures of both foreign and Russian companies. Successes are not numerous. Yet the country is rich in mineral of all kinds. The climate is not worse than elsewhere. There are native races that afford plentiful and cheap labour. The Russians themselves are capable of affording satisfactory work, when wisely handled and persuaded out of the ever recurrent holiday. Here then are integral elements of success. Per contra, an unfavourable feature is the woeful lack of railroad communication, but this defect is being remedied. Freight by road transportation is incredibly cheap, although necessarily restricted in volume. Hence mining, especially in base metals, is restricted to comparatively high grade ore worked on a modest scale.

Where then does the trouble lie? It is due to several causes, all more or less akin. There is the paternalism of the Government; the inertia of unprogressive centuries; the red tape of officialdom; last, but not least, the palpable unpalatable fact that foreign companies are not permitted to run their affairs in their own way. All foreign companies virtually become Russian and operate as such.

Foreign money, as elsewhere, is welcome in Russia, but I do not know that this welcome, in reality, extends to foreigners. It was not manifestly so a year or two ago. Either capital once admitted has rights within the country, or its entry should be barred. That is the pith of the whole matter. Official inspection is doubtless advisable there, as elsewhere. When Russian officials are nominally in charge, and reactionary Government officials at their option can dictate the method of working the mine, on pain of stopping operations, then it becomes another matter.

Conditions are more tolerable each year. The older companies have put up a hard fight against obstacles of all kinds, and some are presumably winning. What, however, seems wanted is that all foreign companies, of whatever nationality, should get together, formulate their lawful requirements, and through the proper channels see that they get them. The man with the money, within reasonable limits, certainly has the right to determine the methods adopted to secure remunerative results, and in this laudable endeavour he should receive all the help necessary from Government regulations and local authorities, compatible with the welfare of the community. Has Siberia afforded such to the capital already invested?

Finally, I would repeat that my observations relating to mineral deposits in Siberia leave no doubt regarding ultimate success. What, however, concerns most of us is the present and immediate future. Radical changes in the status of foreign corporations; unhampered control and operation exercised by resident managers and officials, and, conversely, less interference in administration from Government and resident Russian officials is essential to successful and remunerative operation.

A healthy airing of unfavorable regulations and working conditions should do much to amend matters and not to depress the industry. Why cannot foreign corporations enjoy in Siberia, for instance, the same freedom of operation and immunity from interference, coupled with Government toleration and assistance, as obtains in Mexico?

TARANTASS.

Mexico City, April 2.

Porcupine District.

The Editor:

Sir—Our attention has been drawn to a paragraph in your Magazine for March (page 186) relating to the Porcupine Lake goldfield. You state as follows:

"The Scottish Ontario Mining Company organized by the Glasgow firm of J. S. MacArthur & Co., represented on the ground by Peter McLaren, holds six of the Bannerman Claims, etc."

Similar statements having appeared in Canadian newspapers, we beg to inform you that the information, in so far as it relates to Messrs. J. S. MacArthur & Co., is not quite accurate.

As a matter of fact, they did not organize this syndicate, but were employed by the promoters as experts to report on the claims. They are still associated with the syndicate as consulting engineers, and Peter McLaren has been appointed by the syndicate as manager at the mine.

DUNLOP & MURRAY.

Glasgow, April 16.

Sintering of Copper Ores.

The Editor:

Sir—Mr. Walter G. Perkins, in his article (in your March issue) on the sintering of copper ores for blast-furnace smelting, has specified a slag of 48% SiO_2, 9% Al_2O_3, 20% FeO, and 20% CaO as being too refractory for rapid reverberatory smelting. Now Peters says: "The Swansea smelters long ago found out that it did not pay them to flux all the silica when running on a highly quartzose charge. A reverberatory slag may contain close on 50% of unmelted fragments of pure quartz and yet be clean and satisfactory; the main requirement being that there shall be a sufficient proportion of molten slag to float the unfused particles and enable the worthless portion of the charge to be dragged out of the furnace without carrying with it the valuable part. This species of liquation may at times be used to great advantage." (Peters' 'Modern Copper Smelting,' page 234.) I confess, however, that a large furnace could hardly be worked rapidly with its contents in such a condition, unless some method could be devised for quickly removing the slag. When all of it is to be brought to a fluid condition the slag of a composition above specified might be of the maximum grade in silica.

Mr. Perkins states that when rapidly smelting a refractory slag the roof may soften or even melt. We may here borrow a leaf from the book of open-hearth steel practice, where it is necessary to avoid this very thing. In open-hearth work the roof is particularly exposed to such a mishap and the difficulty is overcome by arching it. In the long reverberatory it should be possible to diminish the action in the same way by having the roof high. The flame, as it enters the hearth, is carried horizontally by the draft near to the charge (upon which it has its full effect) while the more distant roof is removed from the sharpest action. Intense action upon the charge would also be aided by the admission of the air by ports in the bridge-wall *below* the burning gases. In a word, the roof should be domed where the greatest heat of the furnace exists. If so formed, and if made of a good grade of silica brick, the anxiety will be rather to obtain a sufficiently intense temperature than to preserve the roof.

L. S. AUSTIN.

Salt Lake City, April 4.

Mining & Metallurgical Society.

The Editor:

Sir—When you fill your columns with accounts of the House of Guggenheim and criticisms of the great South African revolutionist, John Hays Hammond, you are probably within your prerogatives as editor of a technical periodical who has taken upon himself the onerous duty of moral censor to the mining world. However far you may occasionally go beyond the limits of good taste in such matters, you at least have the courage of your convictions and fear not to publish what others restrict to gossip. But when you indulge in repeated flings at an altruistic organization such as the Mining & Metallurgical Society is designed to be, you serve no good purpose save to advertise the Society, to annoy your friends who are in it, and place yourself in a position inconsistent with the moral doctrines you have been preaching since you gave up engineering and became an editor. Either you meant what you said or else you lay yourself open to a suspicion of hypocrisy, for the Mining & Metallurgical Society was organized to carry out many of the reforms you so often advocate. That it has received the active support of some score or more distinguished American engineers shows that its purpose appeals to many upright, earnest, and busy men of affairs.

The Society as a body arrogates to itself absolutely nothing save the indisputable right to say who may become its members, and I venture to assert that any mining or metallurgical engineer or geologist who is known to be an honest and honourable man or who can meet the perfectly proper requirements demanded of membership in a strictly professional organization may now be elected. Dr. Raymond in his management of the American Institute of Mining Engineers has not seen fit to hold its large membership to a strictly professional body, hence its name is somewhat of a misnomer, for the engineers in it are probably a minority. In consequence of this condition it was felt by some persons that Dr. Raymond has neglected a great opportunity of benefiting the profession and mining industry in other and more ways than the Institute is now doing. When the creation of the Mining & Metallurgical Society was first contemplated, but before being finally organized, an effort was made to have the character of the American Institute of Mining Engineers changed by grading its membership and placing its management more under the control of the strictly professional element. This effort failed, as it was perhaps well it did, for the task would have been all but hopeless. The Mining & Metallurgical Society was consequently started and has gone its rather difficult way accomplishing even more than the large measure of good you accord it. The social features that surround its gatherings have been most agreeable, making new friendships, cementing old ones, and conferring an inestimable benefit upon those who have been enabled to take part in, or to listen to, the free discussion of congenial topics seldom touched upon by any of the other engineering organizations or the technical Press. Some of us therefore feel the existence of the Mining & Metallurgical Society has justified itself and hope it may continue and broaden its field of usefulness and helpfulness until it contains within its membership every man who has the qualifications, approves of its objects, and desires to join in its activities. To assert that we have no right to the name adopted because of small numbers is illogical, for doubtless the now great national engineering organizations, like the Institution of Civil Engineers or the American Society of Civil Engineers, began in quite as humble a manner yet placed their qualifications for membership upon a high plane. The Institution of Mining & Metallurgy was similarly constituted, but is yet comparatively young and small.

The members of the Mining & Metallurgical Society are well aware of its defects, and it seems to as humble a person as the writer very poor taste for you as a member gratuitously to publish our troubles and matters of an obviously confidential character. You would not venture to do such a thing of any social club in which you are a member and it is hard to see much difference in propriety as regards the Mining & Metallurgical Society. The words you quote from the recent address of President Munroe show that we are fully sensible to the defects of our organization and mean that they shall be corrected; we have not waited until you proclaimed them to the world before undertaking the task. The highest function of an engineer is constructive. Surely you are not following the traditions of your former craft or the best instincts of journalism in seeking to destroy what you cannot replace with something better. It is not in human nature to mildly stand ridicule when undeserved and illogical and this case is no exception; moreover, some of your statements are evidently based upon misinformation for they are not correct, especially those relating to the Philadelphia section.

F. LYNWOOD GARRISON.

Philadelphia, March 28.

[Mr. Garrison is entitled to his protest. We are sorry to hurt the feelings of anyone, especially those of a friend. As to taste: *De gustibus non*, etc. Conceivably it may be more profitable to be a censor of morals than of taste; in any event it would be more useful to state in what respect our account of the Philadelphia meetings was incorrect.—EDITOR.

A Protest.

The Editor:

Sir—In your issue of November, I observe a review of my book 'Mexico,' in which your reviewer spoils what might have been a good account of the work by a long nagging paragraph regarding the mineral resources. Your reviewer, I take it, from his initials, is an engineer who himself produced a book on the same subject, but it seems remarkable that one engineer should fall foul of the work of another. The book is not meant to parade technical knowledge of mining: it is historical, descriptive and topographical. Had I desired to give a technical dissertation on the subject probably my ten years' professional work in Spanish-America would have enabled me to do it. Not content, however, with lamenting the absence of technicalities your reviewer takes upon himself to object to some of the literary attributes of the book, and baulks viciously at some words which the printer seems to have put in italics. The rest of his review, however, is appreciative, but the whole goes to show how the specialist often, when let loose into fields where a broad horizon should open up to him, is unable, by habit, to lift his eyes thereto.

C. REGINALD ENOCK.

London, April 7.

A Correction.

The Editor:

Sir—In the prospectus of the Pacific & Orient Oil Co., which is advertised in the public Press, the name of Dr. M. J. Stephan is followed by the initials M.I.M.M. I am directed to request the courtesy of your columns to state that Dr. Stephan is *not* a member of the Institution of Mining and Metallurgy.

C. McDERMID,
London, May 4. Secretary.

OIL IN CALIFORNIA

CALIFORNIA'S third oil boom is now in progress. While not yet at its zenith, it already rivals the activity of the booms of 1865 and 1898. Pioneers of the State's first oil boom are among the most active participants in this third excitement, and in the descendants of some of those old adventurers the present development finds its most daring exponents. A few there are who 'wild-catted' throughout the first and second boom, and these are today still at the front.

The presence of petroleum and asphaltum was known in the early fifties; as early as 1856 some lubricating and illuminating oils were obtained from the seepages in crude stills. The first real excitement came in 1865, when the oil industry in Pennsylvania was flourishing and when investors were in the right mental condition to become excited. A favourable report on Ventura oil prospects started things. Wells were drilled from Humboldt to Ventura. These were usually located without good judgment and the results were disappointing except in Ventura county, where a few productive wells were obtained, some of which are still yielding oil. The oil was of good quality and sufficed to start a local industry.

Few attempts were made to extend exploration until 1892 when E. L. Doheney drilled a shallow well near the asphalt deposits of Los Angeles. This proved to be a steady producer of heavy oil; interest was revived; in the next few years several hundred wells were drilled in the neighbourhood, and many of them were successful. This success caused a resumption of active prospecting. In 1895 Chanslor and Canfield brought in a small well in the old Oil City pool at Coalinga. This aroused some interest; and when in 1896 the Home Oil Co. brought in Coalinga's first gusher, the famous Blue Goose, the spark was in the timber and the second boom was on.

This is recent history and little need be told. Several thousand companies were incorporated and many of them spent the money realized from the sale of stock in legitimate wild-catting. Their success was phenomenal. Productive wells were obtained in the Kern River, Sunset, McKittrick, Midway, Whittier, and Fullerton oilfields. The Kern River field is shallow and the great activity in drilling caused the production to reach such proportions that the market was greatly over-supplied. The oil was heavy and difficult to refine. The use of it as a fuel was not yet appreciated and transportation facilities were inadequate. A disastrous result was inevitable: the price dropped from $1 per barrel to 15 cents, and the boom went the way of others.

Then ensued a period in which the industry was seeking for equilibrium. By a vigorous campaign of education, the consumers were made to realize that, owing to its high percentage of heat units, its low flash point, and the ease with which it could be handled, the heavy oil was a splendid substitute for coal. The consumption grew slowly until in 1907 the demand had exceeded the supply, and the large marketing companies were drawing on their stocks. This was realized by the small producers, who demanded and received a higher price for their oil. The result was the renewal of development. Production increased enormously during the next two years. Consumption likewise continued to increase, and is still doing so. The boom is vigorous and but for a greatly increased production there seems little reason to expect an abatement. Should the present wild-catting prove nearly as successful as did that of 1898 there would be ground for such a fear. In 1909 only one new locality was proved. This was in the Simi hills of Ventura county. Already in 1910 a new field in the Buena Vista hills of Kern county has been demonstrated. These hills promise to produce a large quantity of oil. Drilling is reported from the following localities: Bear River and Mattole, in Humboldt county; Pt. Arena, in Mendocino; Bella Vista, in Shasta; Red Bluff, in Tehama; East Napa, in Napa county; Benicia, in Solano; Guinda, in Yolo; Petaluma, in Sonoma; Mono Lake, in Mono county; Haiwee, in Inyo; Livermore and Altamont, in Alameda: Halfmoon bay, in San Mateo; Los Gatos, in Santa Clara; Parkfield and Lonoak, in Monterey; San Migeul, Miles station, and Carriso, in San Luis Obispo; Vallecitos valley, in San Benito; Kettleman hills and Kreyenhagen, in Kings county; Devil's Den, Lost hills, Temblor, Elk hills, San Emedio and Tejon, in Kern county; Orosi, in Tulare county; Simi hills, in Ventura county; Santa Monica mountains, Rapetto hills, and San Pedro hills, in Los Angeles county; Lompoc, Los Olivos, and Carpenteria, in Santa Barbara county; Kramer, in San Bernardino county: and Newport Bay, in Orange county.

MILLING OF LEAD-SILVER ORE. I.

By GELASIO CAETANI

Introduction. In these two articles I have summarized the results of a series of experiments made during the last three years, with the object of determining the most suitable metallurgical treatment of the lead-silver ore mined by the Bunker Hill & Sullivan Mining & Concentrating Co. It is my purpose to give only the final results of these experiments, together with the conclusions to which they have led, rather than endless tabulated data, which the average reader would have neither the time nor the interest to decipher.

To the liberality of F. W. Bradley, president, and Stanly A. Easton, manager, of the company, I owe permission to publish the results of these long and costly experiments.

THE MINE: The Bunker Hill & Sullivan mine is situated near Wardner, in Shoshone county, Idaho, and is one of the largest lead-silver producing mines in the world. Its total output up to the end of the year 1909 has been about 4,100,000 tons of ore, yielding 789,000,000 pounds of lead and 15,300,000 ounces of silver. (See Fig. 1).

The general strike of the orebodies on what is generally known as the Wardner vein, is northwest, with a southwesterly dip. These large orebodies have been deposited along the lines of numerous fault-fractures in Cambrian quartzite and extend irregularly, and sometimes for hundreds of feet, from these faults.*

TABLE I.

Lead	13·58	Galena	15·70
Silver	(6 oz.)	Silver (as argentite ?)	
Iron	22·85	Pyrite	3·15
Manganese	2·03	Siderite	44·30
Zinc	1·80	Rhodochrosite (?)	4·25
Sulphur	3·80	Sphalerite (?)	2·70
Carbonic Acid	25·17	Quartz	23·90
Silica	23·90	Not determined	6·00
Not determined	6·87		
Total	100·00	Total	100·00

TONNAGES AND ASSAYS OF MILL-PRODUCTS

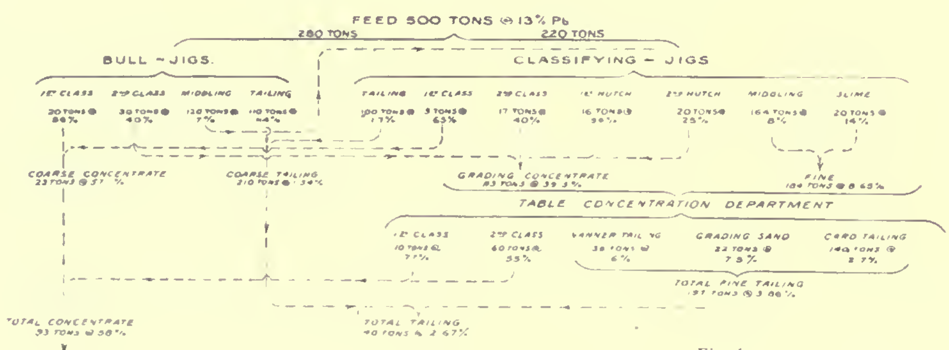


Fig. 1.

THE ORE is a silver-bearing galena, intimately associated with siderite and some pyrite, though carbonate of lead and other secondary minerals are found near the surface. The galena is found in places in a massive state, and is then shipped direct to the smelters, but the bulk of the ore is sent to the mills to be hand-picked and concentrated.

The chemical and mineralogical analysis of the ore is given in Table I, which is a representative sample of the ore supplied to the mill during a period of six months.

* 'Geology and Ore Deposits of the Coeur d'Alene,' by F. I. Ransome, U. S. G. S. Bulletin No. 62.

On close examination the crushed mill-ore appears to consist of four chief constituents:

(1) Fragments of varying size, assaying from 18 to 70% lead and consisting of a coarse mixture of galena and siderite, both in crystalline form. The galena is generally coarse in grain, and was evidently deposited by metasomatic replacement of the iron carbonate.

(2) Middling, or spathic iron, assaying about 8·5% lead, 31% iron, and 7% silica. Some of the galena is coarse, and can be liberated by rough crushing, but much of it is minutely disseminated through the iron. The siderite has two characters: in the high-grade ore it is comparatively friable and shows planes of cleavage, while in the low-grade middling it is hard, silicious, and has almost the structure of porcelain, a fact which argues strongly in favour of the theory that the galena is a metasomatic replacement of the siderite, the replacement having taken place chiefly where the siderite was easiest to displace. In the middling the galena is also found filling numerous crevices in the spathic iron.†

(3) Tailing, consisting of fragments of quartzite and vein quartz. The former is almost completely barren, while the quartz often has fragments of galena clinging to it.

(4) High-grade slime.

MILLS: Three mills are at present in operation:

(1) The South mill, with a capacity of 900 tons, built on the ruins of the one that was blown up during the troubles of 1899; since then it has been remodelled at various times, gaining in efficiency but losing in compactness of design.

(2) The North mill, completed in 1907 and designed for the re-treatment of the tailing-dump.

(3) The West mill, which is to be composed of two independent units of 500 tons capacity.

One unit was completed and put in operation in November 1909. This mill embodies all the experience gained during the operation of the other mills and the information obtained from the detailed experimental work done during the last three years. The flow-sheet of this mill is given in Fig. 2.

It is by following this flow-sheet, step by step, that I shall attempt to elucidate the principles on which is based the metallurgical treatment, and to explain the conclusions reached from the experimental work. The process is divided into three stages, which correspond to three mechanically independent departments in the mill, arranged as follows:

1. Preparation of mill-ore;
2. Coarse concentration;
3. Table concentration.

Preparation of the Mill-Ore.—The product of the mine is transported in trains composed of 15 cars, each having a capacity of 3·6 tons, and dumped into the ore-house bin, which has a capacity of 1400 tons. From this bin the ore is fed by hand-controlled chutes on a 42 in. flat rubber belt-conveyor, which delivers the ore in a continuous stream on to grizzlies with $1\frac{1}{4}$ in. clearance intervals.

The ore, dropping from a height of a foot, in a continuous stream, does not choke the grizzlies; therefore the screening is effective.

The over-size is crushed by a No. 5 Kennedy crusher set to $1\frac{1}{2}$in. The under-size from the grizzlies and the crushed ore is elevated by an inclined 24 in. trough belt-conveyor to a set of three 30 mm. trommels, the over-size of which is crushed by 14 by 36 in. rolls and screened in a 30 mm. trommel, the over-size being returned to the rolls. The under-size from the trommels constitutes the finished mill-ore, which, after being mechanically sampled, is elevated to the main storage-bins, capable of holding 1900 tons. These bins are not placed at the top of the mill, but rest directly on the ground, the ore being elevated from them to the mill by means of an inclined belt-conveyor, as will be explained later.

The crushing capacity is about 2800 tons per 24 hours, and a daily run of five hours is therefore sufficient to supply the mill. A crew of four men operates the ore-houses of both the West and the South mill, in one 8-hour shift. Mechanically, the crushing plant does not present any new features: the general arrangement, however, which is similar in many respects to that of the Old Dominion mill at Globe, is a departure from the design customary in the Cœur d'Alene. The advantages are as follows:

(1) The ore is sampled after being crushed to pass a 30 mm. ring. In other mills it is customary to separate the over-size in the mill itself; therefore the ore has to be sampled as it comes from the coarse-crushing machines, that is, under conditions less favourable for obtaining a true sample.

(2) It is better to have the sampling machinery in a separate building, as the entire equipment takes a large amount of space and is cumbersome, wherever it be placed in the mill, owing to the necessity for disposing of the sample discards.

† See also Ransome *Op. Cit.* Page 108.

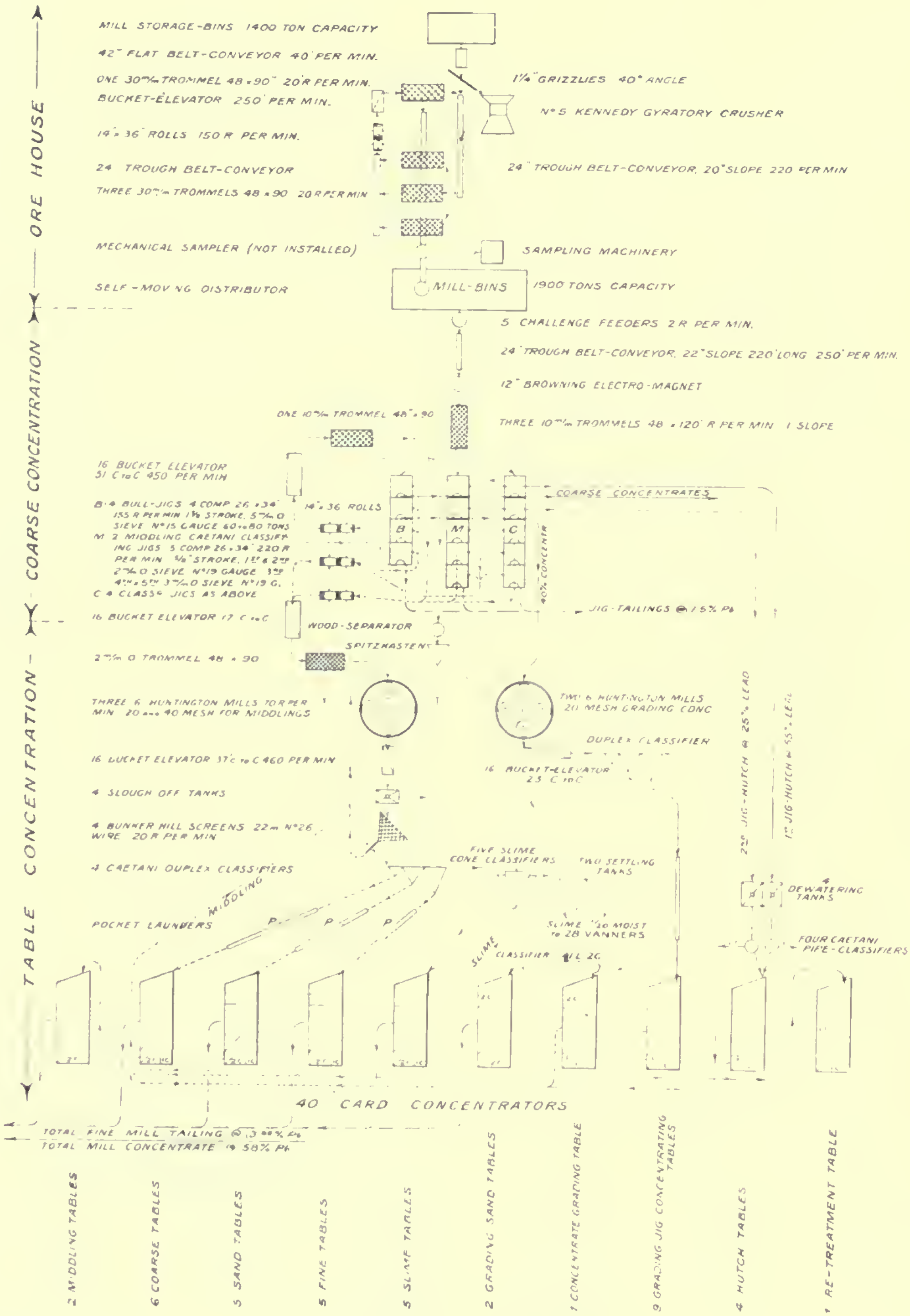


Fig. 2. FLOW-SHEET OF THE WEST MILL.

(3) By dividing the large storage-bins into compartments it is possible to obtain the assays of the ore before it is run through the mill.

(4) Both the screening and crushing of the over-size are done dry and consequently with less wear on the machinery, especially the rolls.

(5) In general practice, the first trommel in a mill has two sets of screens; the first is of medium coarseness and the second one separates the over-size. Therefore, the total mill-ore, over-size included, has to pass over the finer screen. This is avoided by doing the coarse screening in the ore-house.

(6) The crushed over-size is generally elevated from the bottom of the mill (where the over-size rolls are commonly placed) to the very top, whereas if the over-size is crushed in the ore-house, a short dry elevator will answer the purpose.

(7) The over-size rolls in the ore-house are run for only a few hours each day at full capacity, whereas in the mill they have to run continuously and always at under-capacity.

(8) It is possible to have a much larger storage-capacity when building the bins close to the ground than when they are placed at the very top of the mill.

(9) The construction of the storage-bins is cheaper, as it is not necessary to build a heavy and cumbersome sub-structure to support the bins.

(10) The screened ore, when coning in the bins, has less tendency to separate into coarse and fine, than is the case with the coarsely crushed ore.

The crushed ore is fed from the storage-bins by Challenge feeders on to a 24 in. trough belt-conveyor 220 ft. long, which, at an angle of 22 degrees, elevates it to the top of the mill. The feeders revolve at a uniform speed of 2 r.p.m. and can be either belt-connected to one of the conveyor-pulleys or run by a 3 h.p. variable-speed induction-motor, controlled from the jig-floor. The Challenge feeders are the best for finely crushed and comparatively dry ore. The capacity of a feeder can be varied from 150 tons per 24 hours, at 2 r.p.m. with the baffle-plate closed, to 700 tons when run at 4 r.p.m. and with the baffle wide-open.

The ore is delivered on the belt in a uniform stream and the tonnage delivered will not vary 5% if the dryness and coarseness of the supply remain fairly constant. To obviate possible variations, two or three feeders are generally run at the same time, supplying the ore from different parts of the bins.

The Jeffrey trough belt-conveyor, which elevates the feed, is controlled by a clutch placed within easy reach of the jig-men. The conveyor practically requires no attendance.

The ore as it is delivered to the mill passes under a 12 in. 500 volt, ½ ampere, Browning electro-magnet, which removes all the nails, bolts, nuts, etc., which would continually cause trouble in the jigs, launders, and Huntington mills.

Coarse Concentration.—The ore, screened through 30 mm., is delivered at the top of the mill as previously explained, and enters the coarse-concentration department, which consists of 10 mm. trommels, jigs, and rolls. The trommels split the ore into a product of 30 to 10 mm. and another of 10 mm. to zero, which are fed respectively to the coarse and fine jigs.

These jigs, which are described later, split the feed into 14 products. Two of these are concentrates ready for shipment, two are tailings, while the other ten are intermediate products, characteristically distinct, which separately undergo further processes of reduction and concentration. The function of the jigs, therefore, is more that of classifiers and distributors of products, than that of concentrating machines. It is the man who superintends the jigs that regulates the quantity of ore treated and also the tonnage and grade of the products distributed to the different parts of the mill. Thus, the jig-floor is the most vital part—the heart, as it were—of the whole mill.

Before entering into the discussion of the general method of concentration followed, I shall discuss the principles underlying the design of the jigs.

RELATION BETWEEN SIZING AND JIGGING: It may be said that the first action of a jig is to throw to the surface the fine or lighter particles that cannot settle through its bed against the pulsating currents of water. The heavy mineral will settle almost immediately; the middling will do so after a time, but the fine material, once rejected, will pass from one compartment to the other without being able to find its way into one of the products.

The Wilfley table has a similar action on the slime, which, unable to settle between the riffles, is washed off by the head-water. On almost any concentrating machine there is some material that evades the action of the machine and becomes 'outcast.' It is by this word that I shall designate such material throughout this paper.

The existence and character of the 'outcast' in the jig-tailings is illustrated in the following table, in which are compared equal-sized grains screened out of the tailings of five jigs of differ-

Ore-house. Storage-Bins. Concentrating Plant. Slime-settling House. North Mill.

THE MILLS OF THE BUNKER HILL & SULLIVAN COMPANY.

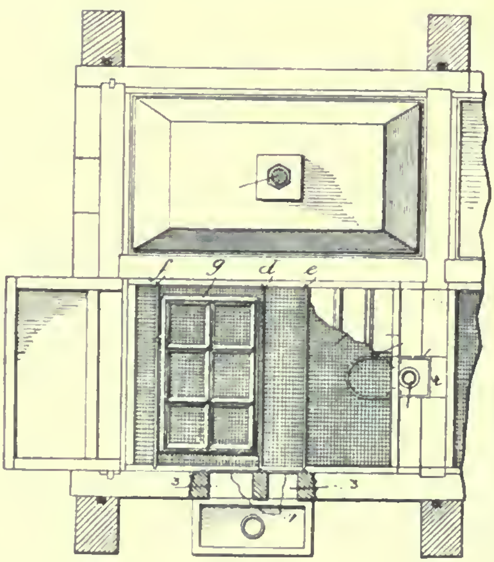


Fig. 3.
Slime-separator of classifying-jig.

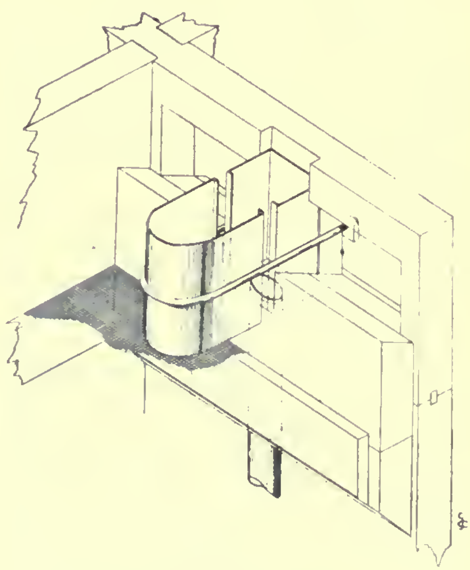


Fig. 4.
Central discharge-cup of Bunker Hill Jigs

ent size. The figures prove that the fine sand remains 'outcast,' especially on the coarser jigs. See Table II.

The character of an 'outcast' material will vary with the type of machine. On the bull-jigs even small pieces of ore will be thrown over the tail-board, and on fine jigs coarse pieces of ore will settle permanently on the sieve. Again, on a Wilfley table and on a vanner, over-size pieces of quartz will mingle with the concentrate.

The first effect of close sizing is the elimination of 'outcast' material and as much, in regard to jigging, as will allow an easy separation and keep the bedding and the grade of the products in a stable condition. This is especially true where the difference of specific gravity between minerals is small, as in lead-zinc ores, and where the ratio of concentration is high.

the Bunker Hill ore is well adapted for jigging.

These observations led to the conclusion that jigging could be performed just as efficiently by adopting in the new mill a much wider range of sizes than is customary in the district. The range of sizes is only limited by the size of those particles that would remain 'outcast' on the jigs to which they are fed.

To determine these points an experimental plant of 100 tons daily capacity was erected and it was found that with specially constructed jigs of the Harz type, it is possible to handle all the mill-ore by dividing it into two products, a 30 to 10 mm. and a 10 mm. to zero feed.

Until recently it has been customary to jig coarser than 30 mm., but, since the lower levels of the mine have been opened, the galena is found to be more disseminated, and consequently the grade of the concentrate, ranging in size from 30 to 36 mm., cannot be kept up to the grade commanding the best prices. The tailings of the coarsest jigs are remarkably clean and it is not, therefore, the tailing loss, but the grade of the concentrate that governs the upper size-limit of the ore to be jigged.

The lower size-limit of the coarse-jig pulp is 10 mm. Sizing analyses show that the 10 mm. particles contained in the coarse-jig tailing are not higher grade than the same sized grains contained in the fine-jig tailing, nor are they appreciably higher grade than the total coarse-jig tailing itself; hence the 10 mm. particles are not 'outcast' when jigged together with the 30 mm. particles.

The under-size of the 10 mm. trommel can

TABLE II.

Size of grains screened out from the jig-tailings.	Size-limits of material fed to jigs. 10-7 mm.	7-3 mm.	3-1½ mm.	1½-1½ mm.	Slime.
	Percentage of Lead.				
Through 3 mm. on 10 mesh	3·00	2·60	1·36	0.94	1·20
Through 10 mesh on 20 mesh	3·13	2·90	1·80	1·29	1·50
Through 20 mesh on 40 mesh	4·81	3·01	2·63	1·59	1·62

TABLE III.

Percentage of product.	Hutch compartments. 1st	2nd	3rd	4th	5th
	%	%	%	%	%
Remaining on 20 mesh	6·0	27·0	31·5	51·0	91·0
Remaining on 60 mesh	52·0	29·0	54·0	40·0	9·0
Through 60 mesh	42·0	44·0	14·5	9·0	—
Lead assay of total hutch	55%	32%	14%	8%	5%

Close sizing, however, is in many instances an accepted and undisputed axiom, and a certain standard ratio of sizes is adopted without any theoretical or experimental guidance. As a consequence we find that sizing is often performed to an extent not justified by the character of the ore, and often it is done *pro forma*, the material, which is supposed to be sized, being practically only freed from slime.

These conditions are to be found in the South mill, where the screening is performed by five sets of trommels ranging to size from 36 to 3 mm. The trommels are overcrowded and their efficiency varies from 50 to 20%, that is, the products separated by the trommels contain from 50 to 80% under-size. Nevertheless, the jigs are doing remarkably clean work, because be fed directly to the classifying-jigs, which first separate the slime and fine sand and then concentrate the deslimed portion of the pulp as described in the later portion of this article.

Both the coarse, or bull-jigs, and the classifying-jigs, are almost of identical design. The only difference is that the first compartment of the classifying-jig is provided with the slime-separating device and that the bull-jig has one compartment less than the classifying-jig.

CLASSIFYING-JIG: This is a five-compartment jig of the Harz type and is characterized by the arrangement of the central-discharge cups and by the slime-separating device of the first compartment. These arrangements are illustrated in Fig. 3 and 4. The first compartment separates the slime and at the same time produces high-grade hutch and gate concentrates.

THE SLIME contained in the pulp is washed to the surface by the heavy flow of plunger-water rising through the bed. Two iron-plate partitions reach across the whole width of the sieve and dip about one inch into the ore-bed. The coarse passes below these partitions, but the slime is prevented from doing so by the rising columns of water, and overflows through side gates. The object of the double partition is to take off the bulk of the slime in the first section and to wash off the remaining part in the second. The separation of slime is practically complete. The material separated consists of slime and some sand, as shown by the following screen analysis:

Mesh..	On 40	On 80	On 150	On 200	Through 200
%.....	17·5	11·5	16·0	4·5	50·5

If the slime-discharge gates are kept low, some coarse material will be also discharged; this coarse material is tailing and is removed with the wood-pulp on the separator, as explained later.

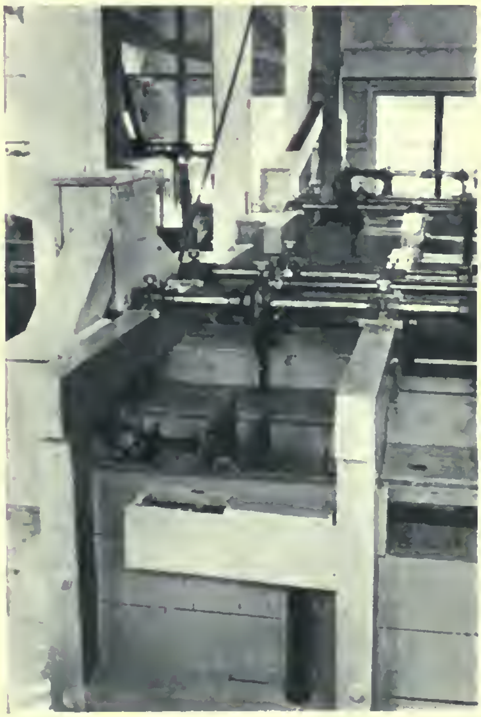
It is by the separation of this outcast material that the subsequent good work of the jig is rendered possible. Of the fine material that has not been thrown off with the slime, the heavier part passes into the hutches and the lighter part is thrown off as tailing.

The five HUTCH PRODUCTS prove to be not only graded, but to a certain extent also sized, the jig acting at the same time as a screening and concentrating machine. The first two sieves are made of No. 19 gauge steel with 2 mm. round punched holes and the three last are 3 mm. No. 18 gauge. The screen does not blind. The results are shown in Table III.

The first compartment can be forced to yield a 75% lead product, but by doing this there is a heavy wear on the bedding, with corresponding production of outcast material.

Under normal working conditions the hutch concentrates will always contain some sand, which is easily eliminated in the subsequent grading by hydraulic-pipe classifiers and Card concentrators, as will be explained.

THE GATE AND DAM DISCHARGES are all placed at the centre of the tail-board. This arrangement, which is giving perfect satisfaction, is illustrated in Fig. 4.



Slime-discharge of Classifying-Jig.

The advantage of a central discharge is recognized by all mill-men, as a central gate will draw the concentrate more evenly from the tail end of the sieve than is possible by means of a side discharge. The layer of concentrate that forms the bedding, as it is drawn toward the discharge-cup, assumes a concave surface of which the cup marks the lowest point, and the farther the cup is placed from the tail-board, the greater will be the probability of some pieces of concentrate jumping over the board. The action of the jig-bed is also more uniform with a central discharge-cup.

HUTCH-BOX AND HOPPER: The relative positions of the sieve, plunger, hopper, and other parts of the jig are given in Fig. 5. The

TABLE IV.

	Tonnage Per 24 hr.	Tonnage %	Lead Assay	Lead %	Silver Assay	Silver %
Feed	72·3	100·0	11·55	100·0	4·9	100·0
Coarse concentrate	3·67	5·3	48·9	21·4	17·9	18·7
Hutch concentrate	9·1	12·8	40·0	46·8	17·6	45·5
Coarse middling	13·9	19·6	5·16*	8·6	2·2	8·5
Hutch middling	14·1	19·7	4·76*	8·0	2·4	9·3
Total middling	28·1	39·3	4·95*	16·6	2·2	17·8
Tailing	20·4	34·2	1·46*	3·6	0·7	4·0
Slime	5·95	8·4	16·25*	11·5	8·5	14·1

* All percentages of lead given in this article are based on the wet assay, except those of the concentrates.

TABLE V.

SIZING-ASSAY TEST OF CLASSIFYING-JIG TAILING.

Remaining on			Corresp. Cum. Lead.
7 mm.	31·2% @	1·19% Pb.	25·5%
5 „	23·2	1·54	50·2
3 „	5·8	1·44	56·1
10 mesh	24·2	1·61	83·0
20 „	11·6	1·24	92·7
40 „	·7	1·20	93·5
60 „	1·6	0·94	94·6
80 „	·8	1·13	95·3
100 „	·3	1·27	95·5
150 „	·2	1·79	95·8
200 „	·1	2·82	95·9
Through 200 „	·3	17·22	100·0

Total assay of tailing 1·45% Pb.

main object of the hopper is to deflect the water toward the sieve; if the hopper be placed lower than is indicated, the ore will settle on top of the deflecting boards.

PLUNGERS: The length and speed of the plunger-stroke depend on the relative size of the plunger and jig-compartments and on the size of the material jigged. When jigging unsized material it is advisable to use a high speed and a short stroke. The fact that the smaller particles of ore occupy the interstitial spaces of the larger ones, gives to the water a greater lifting power on the coarse particles than it would have if acting on sized material. A long stroke on unsized pulp loosens the bed to such an extent that the fine material is either sucked through the screen or thrown into disorder.

The speeds and strokes used are given in the flow-sheet Fig. 2. The plunger must have at least a $\frac{3}{16}$ in. clearance all round, otherwise

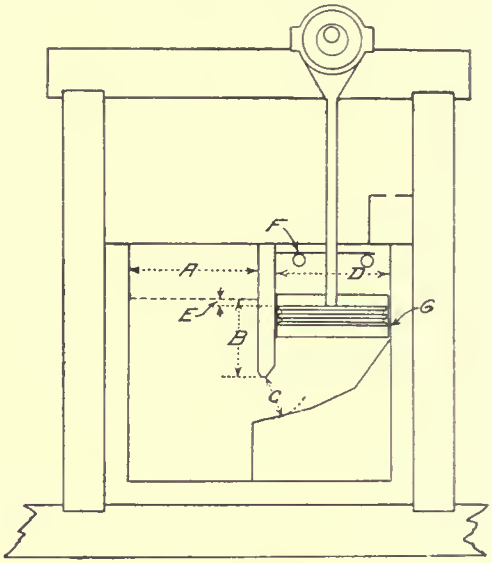


Fig. 5.

the suction through the sieve is too heavy. Plunger-valves have been tried, but without favourable results. The inconvenience of the air-blast caused by the movement of the plunger can be greatly reduced by boring two 2 in. holes through the partitions that divide one plunger-compartment from the other; the air will then circulate forth and back, and will not have the tendency to raise the plunger lid.

THE EFFICIENCY OF THE CLASSIFYING-JIG is given in the accompanying table, No. IV.

The sizing analyses of the tailing show that the losses are uniformly distributed through the various sizes, only the slime, which amounts to less than 0·4%, shows high value due to the fact that it is an outcast material.

(To be continued.)

GOLD MINING IN COLOMBIA

By F. LYNWOOD GARRISON

THE recent notable increase in the cost of living throughout Europe and the United States has called the close attention of economists to the future gold supply of the world and its probable rate of increase. Whether or not these troubles may be directly attributable to a rapidly augmenting production of gold is a question I do not now propose to discuss. Obviously, an annual output of gold in excess of the needs of legitimate business and commercial expansion, as well as to provide for the undeterminable but large consumption of gold in the arts, must cheapen it, weaken its purchasing power, and force prices up. Such a condition has as yet been by no means demonstrated, despite numerous attempts to do so. As a corollary to this subject, we turn naturally to consider the probable future sources of gold, and ask from what parts of the earth it is most likely to come. Omitting the Witwatersrand, whose yield has now probably reached its maximum, and where further discoveries of importance are unlikely, we find three great areas of the world offering the promise of a large and increasing output: Alaska, Siberia, and South America. The possibilities of Alaska are intelligently and correctly set forth in the admirable publications of the U.S. Geological Survey, as well as in those of the Canadian Government. Of Siberia we know much less, despite the fact that this vast territory has been largely productive for over a hundred years. Anyone who reads the recent annual report of the Lena Goldfields, Limited, published in the December issue of *The Mining Magazine*, must be astonished by the remarkable, though evidently truthful, statements made therein regarding the richness of the Lena valley alluvial deposits, and the enormous possibilities apparently existing in Siberia. That South America must contain great natural stores of gold has been known since the days when Pizarro and his piratical gang of cut-throats wrought death and destruction to the unfortunate aborigines of Peru, but since the expulsion of the Spaniards its gold production has decreased and failed to respond to the touch of modern methods. Many forces have conspired to this end: bad government, unhealthfulness, absorption of speculative capital in other countries, but most of all the difficulties attending transportation; doubtless other contributory causes might be adduced, but the above suffice.

I hold no brief for Colombia, and possibly in once more taking up my pen on behalf of this interesting and geologically little known

Fig. 1. Native, with batea, in front of a bank of gold-bearing gravel.

country I may be accused of 'writing up' a region in which I have some small interests for the purpose of engaging capital to make them valuable. I submit, however, that Colombia is a country worth knowing, and, having been there and taken advantage of a few opportunities thrown in my way, I should be less than human did I not tell what I have seen, and bid others go and do likewise. Nor need my testimony go unsustained, for if the reader will refer to the October (1909) issue of this Magazine, on page 147, and also the report of the Oroville Dredging Co., printed in the advertising columns, he will find there some official statements relative to Colombia, both interesting and informing.

Practically nothing is known of the geology of Colombia, except scraps of observation, collected by busy, often fever-stricken mining engineers, who like myself have been sent there to make reconnaissance surveys in a few weeks, when systematic studies covering many months, or even years, were necessary in order properly to understand and correlate the geological conditions. I have searched in vain for anything worth reading, that has yet been published on the subject. This much we do know: Colombia is an extensive mountainous country, the highlands of which are drained to the north by a system of great rivers flowing into the Caribbean Sea, and on the east and southeast into the Atlantic Ocean by the tributaries of the Orinoco and Amazon. In the commercial sense the river systems last mentioned are at present unimportant, and it is to the former, especially the Magdalena, that I wish to direct attention. At the equator, on the southern frontier of Colombia, the Andes divide into three great ranges, one trending eastward to the Bogota plateau, the others known respectively as the Central and the Occidental cordillera, extending north in approximately parallel lines through the States of Cauca and Antioquia. On the eastern flank of the Central range, between it and the Bogota complex, flows the Magdalena, one of the largest rivers of South America. Between the Central and Western ranges we find its largest tributary, the Cauca. At about Lat 8° N. the Cauca is joined by the Nechi, upon which, near the town of Zaragoza, is the property of the Oroville Dredging Co., referred to above. The Cauca is navigable for river-steamers as far as Valdivia, and the Nechi to Zaragoza and a short distance beyond. On the Cauca, from Valdivia to Cali, are a succession of wild gorges and canyons through which the river flows; these are said to be unrivalled in South America: from Cali to Popayan the Cauca is locally navigable by small steamers. Not being personally familiar with the Cauca above Valdivia, I am not certain that these limitations as to navigation are more than approximately correct.

When the Spaniards under Quesada, in 1537, reached the Bogota plateau, they found the natives there enjoying a relatively high civilization, and possessed of enormous quantities of gold. Every effort failed to find the source of this gold in the vicinity, and it was soon determined that the Bogota plateau natives obtained it from their more barbarous brethren over to the west in the valleys of the Cauca and Atrato rivers. Subsequent explorations by the Spaniards proved this to be correct, and during the seventeenth and eighteenth centuries the amount of gold produced by Colombia is assumed to have amounted to nearly four hundred millions of dollars, evidently derived chiefly from the valleys of these large rivers and their tributaries. Undoubtedly most of this gold must have been obtained by hand-washing the river gravel with the ***batea***, but we know for certainty that quartz veins also yielded a substantial quota. The primitive stamp-mills introduced by the Spaniards still survive in the mountainous districts; they have been pounding away through the centuries, yielding a modicum of gold on a maximum expenditure, power, water, and efficiency. Such stamps are as crude and simple as were those old German mills so admirably illustrated by the woodcuts of old Agricola in his *De Re Metallica*, published at Basle, in 1621.* These primitive mills then, as now, worked only the oxidized ore or upper portions of the gold-bearing veins, and probably at no time was the amount of gold so obtained large. Everywhere throughout those portions of the Cauca valley visited by me I found evidences of large alluvial workings in olden times. In size they are much bigger than any of the operations now being carried on by the natives, but it is probable that they differed little in method or system. Small streams with a natural fall were turned over the gravel-banks, sluices on bedrock, wooden sluices similar to those illustrated in Agricola's book, and water carried in conduits or pipes made of the bark of trees, as shown in the accompanying photographs. It is difficult to believe that so much gold as the old records show could be obtained by these crude appliances, but it must be borne in mind that the Spaniards enslaved the Indians for the purpose of washing gold, paid them nothing, and perhaps were not over-fed, even in a country where food was cheap. That these poor creatures were literally driven to death and treated with the utmost barbarity, the old writers, especially Las Casas, all attest. Even so late as 1852 the famous engineer J. C. Trautwine says of the Indians near Quibdo:

*I suppose most of the older mining engineers are familiar with this justly famous old book, especially those who have studied in Germany. Agricola's real name was Bauer. He wrote both in Latin and German, and his work went through several editions. The copy I possess is written in Latin and bears the date 1621. I think there are one or more earlier editions, possibly ante-dating this by ten or fifteen years. My copy is divided into twelve books, a long chapter entitled *De Animantibus Subterraneis*, and an excellent index, which from thoroughness might be commended to some modern publishers.

"Here they are strongly adverse to searching for gold, probably in consequence of their traditional sense of the horrid barbarities which its possession entailed upon their ancestors at the time of the Spanish Conquest. They concealed all knowledge of rich locations; even took the trouble to obliterate evidences of their existence."

Colombia.

The most interesting observations regarding the gold alluvium of the lower northern river-valleys in Colombia have been recently called to my attention by J. C. Trautwine, Jr., of Philadelphia, son of the distinguished engineer above mentioned. In 1852 the elder Trautwine was engaged in making reconnaissance surveys for an inter-oceanic canal by way of the Atrato and San Juan rivers, with a view to discovering a feasible route from the Gulf of Darien (Uraba) to the Pacific. As his work resulted in an unfavourable report upon this scheme, and as far as we know, he never expected to return to Colombia, or had any pecuniary interest therein, his observations may be accepted as free from bias. Moreover, he possessed some knowledge of geology, and was a mineralogist of distinction. Trautwine's rough notes were published in the Journal of the Franklin Institute in 1854, and from them I quote at length. Speaking of the Quibdo district on the Atrato river, he says: "I first supposed Quibdo was so far removed from the sources of the gold in the Western Cordillera that the force of the current of the Cabi and Quito had not been sufficient to transport the particles to this point. But as I afterwards saw very rich deposits at a greater distance from the place of origin, I was obliged to abandon this idea, and to substitute for it that of a casual inequality of distribution. Gold has not been found west of the partition range of hills between the Atrato and the Pacific. But east of it, from below the latitude of San Pablo, it everywhere occurs in the alluvial gravel up to the very foot of the ridge. Near the head of the Surucco I saw negroes washing rich gold gravel at an elevation of some 30ft. above the level of the stream. The entire bed of the Quito, together with those of its eastern tributaries and all streams between it and the Western Cordillera, are throughout rich in gold. It is not, however, until we approach to within a few leagues of the Cordillera, that the particles assumed a size larger than gold dust. I secured specimens from many localities far apart, and generally found them to be accompanied by platina. In all cases the gold was remarkably pure. Wherever bluffs of gravel showed themselves along the river above Quibdo they contain gold.

The Andagueda has the reputation throughout this region of furnishing great quantities and particles of larger size than any other of the tributaries of the Atrato. It will be seen from the map that this stream descends with several ramifications from the spurs of the very Cordillera. The gravel of its bed, especially in the more elevated section, is represented as being surprisingly rich." In the neighbourhood of San Pablo, on the head-waters of the San Juan river, about Lat. 5° N., "nearly the whole surface of the country is covered by a thick layer of gold and platina-bearing diluvium. Even the hill of Barro Blanco, which is 247 ft. above San Pablo, appears to consist exclusively of it, and there is not a single stream from the bed of which these metals may not be extracted." He goes on to say: "I will tax credulity still further by asserting that gold dust is actually daily collected (almost indiscriminately as regards details of locality) over an area of at least some 2000 square miles of the western slopes of the Western Cordillera; while the exportation of it from the eastern slopes of the same range annually amounts to some millions of dollars. It is not the Atrato and San Juan alone that penetrate to the El Dorado of New Granada. The Great Magdalena, together with its great tributary, the Cauca, 'roll down their golden sands' from the same inexhaustible repository of nature's treasures."*

The existence of platinum in Colombia is especially worthy of note, since, with the exception of certain districts in Russia, it appears to be more abundant here than in any other known part of the world. Humboldt mentions its existence in the Choco district (that is, the valleys of the Atrato and San Juan, between Lat. 1° 30′ and 6° N.), and it seems to have previously attracted the attention of the Spaniards, who took it for silver, as is attested by its present name, *plata* being the Spanish for silver. It is said to be in great abundance in the western part of the Department of Cauca, more especially between the western foothills of the Western Cordillera and the Pacific. On the Cauca river platinum is rather uncommon. I saw it washed out with the gold at Icobo, and one of my men obtained a few specks in testing gravel on the west bank of the Cauca below Caceres. In large modern gold-washing operations there is reason to suppose a considerable proportion of platinum may be obtained along the Cauca river. Its source can doubtless be traced to peridotitic rocks in the Western Cordillera, especially where the largest area is exposed to erosion, in that portion of this range drained by the eastern branches of the San Juan and Atrato rivers. At the present time the value of platinum appears to be unknown and unsuspected by many of the natives in the Cauca valley, and I understand traders and storekeepers sometimes penalize them for its presence in the gold taken in barter.

Journal, Franklin Institute, Vol. LVIII. (1854), p. 221.

The geology of Colombia, as a whole, is unknown; although the general conditions obtaining in the Cauca and Atrato valleys seem to be pretty well understood. As in most of the important gold-yielding districts of the world, the country rocks here are Archæan, or at least pre-Cambrian. The mountain ranges, especially the Western Cordillera, are largely composed of basic eruptives, especially andesites, which have been thrust up through the metamorphic rocks. These are everywhere cut and traversed by an enormous number of quartz seams or veins, some of great width and persistence. Nearly all of them carry gold, but are usually lean, as is generally the case under similar geologic conditions elsewhere. The andesitic rocks also carry gold in themselves, accompanied by an astonishing amount of pyrite; in fact, it is extremely easy to find numerous rolled fragments of such rocks in the benches and bars of the Cauca river, between Valdivia and Caceres. I have never yet failed to find pyrite in these pebbles, often in large amount and doubtless a fire assay would also show the presence of gold. As any placer miner will understand, the distribution of the gold in the ancient, as well as existing, river benches and bars of Colombia is exceedingly irregular; I have myself found as much as $10 per cubic yard, and doubtless many such rich spots exist. What might be taken as an average over any considerable area in the absence of systematic prospecting cannot be stated, and one guess is as good as another. On the Nechi the Oroville Dredging people obtained 31·31 cents per cubic yard over 310 acres;* I venture to say as much, or even more, ought to be obtained over equally large areas in the Cauca Valley.

To call especial attention to extraordinarily rich spots is misleading to the lay mind, and serves no good purpose. The gold is there, and over immense areas: that it can be obtained at a large profit to the experienced and well-equipped operator seems to be the opinion of every competent person who has been in this region. A number of failures have to be re-

*Report, Oroville Dredging Co., Ltd., *The Mining Magazine*, Oct. 1909.

corded, however, but they appear to have been due to ignorance, poor equipment, and dishonesty, more than to anything else. Similar experiences are the portion of every alluvial gold district in the world, and will so continue

Gold-Washing. (Oviedo.)

until practical men of financial strength and honest motives undertake such operations in a business-like way, in other words, to get the

Fig. 2. A primitive pump.

gold from the ground rather than from the pockets of a credulous public. A noteworthy character of the gravel in the Cauca valley is that it seems to be richest, not on bed-rock, but in layers several feet above, and that there may be several such layers in a bank, separated one from the other by comparatively lean material. This is well illustrated in the accompanying photograph, illustrating a small hydraulic operation at Icobo in the Cauca river. The dark spots following a waving line on the face of the bank, indicate such a rich seam, the natives having gouged it out in places in order to wash the rich gravel therefrom in their *bateas*. I think there were at least two, or possibly three, such layers at this place, one of which was certainly richer than the bed-rock.

Fig. 3. Hydraulic Mining at Icobo.

In the vicinity of Caceres the Cauca valley broadens out, the Western and Middle Cordillera trending farther away and gradually disappearing to the north into the great plain of the Magdalena. Where this divergence begins at about the Apavi ranch we find the Archæan rocks overlain by sedimentary beds composed of sandstone, grit, and shale, sometimes containing thick seams of a non-coking coal resembling cannel. From a careful perusal of Trautwine's narrative it would appear that similar conditions exist on the Atrato river. He does not, however, mention the existence of coal on that river, but speaks of thin beds of lignite. In the Cauca valley these soft sediments (which are probably Jura-Trias in geologic age) are almost everywhere overlain by gold-yielding gravel, and as such areas are often approximately flat they offer excellent opportunities for successful dredging. In none of these places did I observe boulders of any size. By reason of the soft bed-rock, absence of clay in the gravel, and an abundance of water, the conditions for successful dredging seem well assured. In no case did I observe the gravel much cemented, but in frequent instances the ingredients were much decomposed and the particles of gold derived tnerefrom often coated with iron oxide ; hence amalgamation may be difficult.

The purity and physical condition of the gold change according to the distance it has travelled from its source in the veins of the metamorphic, and probably also in the eruptive, rocks. Usually here, as elsewhere, the farther the gold has been carried the finer the grain and the less silver it contains. Thus, for example, at Valdivia, where the mountains approach close to the river, the gold-bearing gravel, or detritus, is coarse, and often more or less angular. Evidently it has not travelled far (see accompanying photographs). The associated gold is consequently also coarse and much less pure than farther down the river. Some of the bars and beaches on this upper part of the river are of extraordinary richness; the natives sink pits in them as deep as their primitive pumps will handle the water (see Fig. 2 and 4). At Caceres and below we find the natives working only as shown in Fig. 5, or else driving drifts into the richer layers in the beds that rise high above the water's edge along the banks of the river. The gravel from such places is carried down to the river in *bateas* and there washed by hand.

In those parts of the Cauca valley where the mountains are close to the river, the tributary streams run a short course, with many rapids and falls ; hence it is probable that suitable water-power sites may be found here at a number of places. Farther down the river, in the vicinity of Caceres, such facilities are uncommon, or do not exist at all, consequently large power-plants for the operation of dredges will have to be selected some distance away, say 20 or 30 miles. Power-plants using the coal of the district might be installed, and could be made efficient and economical if this coal were used in gas-producers and gas-engines. The coal that we found near Caceres contained 47% volatile matter and 32% fixed carbon only, with $4\frac{1}{2}$% ash, and a large amount of moisture. How much of this material can be mined it is impossible at present to say, for absolutely no development work has been done upon any of these coal deposits.

Too much stress cannot be laid upon the natural advantages possessed by this part of Colombia in the way of transportation. Cargoes from New York to Caceres will require but two handlings, from the steamer to the cars at Savanilla, thence by rail 17 miles and unloading to the river steamer at Barranquilla. Stern-wheel steamers such as are used on the Mississippi and its tributaries, can ascend with ease from Barranquilla to Caceres on the Cauca river, which place is about 600 ft. above tide. It is possible for small steamers to reach Valdivia when the water conditions are favourable; above Apavi there are some bad rapids to pass, but nowhere between these points are there any rapids as difficult as those on the Yukon at White Horse. The actual distance from New York to Caceres is 2250 miles, of which 1883 miles is by sea, 17 miles by railway and 350 by river steamer. New Orleans and the Gulf ports are of course much nearer, but a few hundred miles more or less by ocean-transport makes little difference in cost. Obviously the cost of getting machinery and supplies from New York to Caceres must be low under normal conditions, and truly this is exceptional in South America, especially as compared with the countries on the west coast. The moment land-transport must be substituted for water, the costs increase enormously ; roads in Colombia are atrocious, and in the rainy season even the best of the mule-paths are abominable to a degree difficult to appreciate by any one who has not travelled over them. Water transport similar to that on the lower Cauca probably obtains for the Atrato river, by way of Cartagena, and it is said that the San Juan may be reached by a short portage from the upper waters of the Atrato. As these rivers are smaller, navigation on them may be rather more difficult and expensive than on the Magdalena and Cauca ; upon this point, however, I have no personal knowledge. The upper Cauca valley, that is in the neighbourhood of Cali, may be reached from the port of Buena Ventura on the Pacific coast, thence by a partly constructed railway.

In the foregoing sketch I have given some of the favourable conditions and recommendations for Colombia as a future mining country, but there is another side, and to that we should give due consideration. Any tropical country lying less than 1000 ft. above sea-level, having a heavy rainfall, will be more or less malarial, and provide virulent forms of that disease. These cannot be treated with impunity. It is true, none of these districts in the lower valleys of Colombia can be worse than was Colon be-

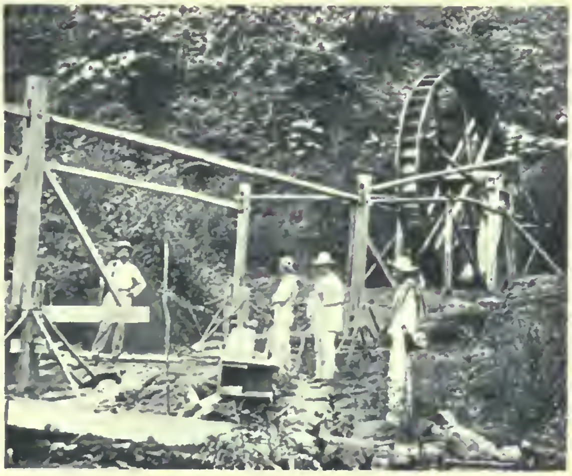


Fig. 4. Another primitive pump.

fore the Panama Canal officials undertook and succeeded in making that pest-hole a fairly healthy place. Modern science and engineering have done much to rob malaria of its terrors, and if infection from this disease can be avoided, a healthy man should be perfectly well in the tropics, provided he is abstemious and rational in his way of living. Of course, one man's view of rational living may differ from another's; it is a debatable subject. For my own part, a total abstinence from alcoholic liquors is absolutely necessary in the tropics; one should eat as little meat as possible, and confine the diet to fruit, eggs, cereals, and the like. I suppose most men who have lived in the uncivilized parts of the tropics have found it difficult to get fruit and comparatively easy to get meat, when indeed it is possible to get anything to eat. Pork should never be eaten except in cases of extreme need—the reasons need not be explained.

Fig. 5. Natives washing for gold.

A great deal might be said about the shortcomings of the Colombian government, and in truth its defects are not a few, from our point of view. But whose fault is it that virtual anarchy and despotism exist today in all Central America except Costa Rica, and to a considerable degree in Venezuela and Colombia, if it does not lie at our door? I speak as an American. Such deplorable conditions as now exist would not be tolerated in any other part of the world. The civilized powers of Europe regard these countries, justly I think, as within the American sphere of influence, and truly say that their good conduct should be a matter of the first concern to the United States. The same Quixotic spirit that caused us to give premature independence to Cuba and entailed so much trouble and opposition to our occupation of the Philippines, prevents us from interfering with the internal affairs of these unfortunate countries. The policy of *laissez faire*, until we are ready and need this great territory for our own expansion, may be good business in a commercial and political sense, but it is certainly cruel and unchristian. To force a neighbour to put his house in order is not a proof of aggression, but of neighbourliness. In truth, we turned Spain out of Cuba because we were subjected to periodic invasions of yellow fever from the neglected ports of that country. Fear of pestilence caused the war with Spain and drove her for ever from the last of the colonies in South America she so sadly misgoverned. It is safe to say that the existing governments of all the above-mentioned countries, with the exception of Colombia and Costa Rica, are today much worse than that of Spain in Cuba.

The ease with which substantial improvements in the governmental conditions of these countries might be effected under American directions, is perhaps well illustrated by the history of recent events in the island of Santo Domingo. About 1905 President Roosevelt intimated to that country that conditions there were becoming intolerable, and European governments must soon take some action for the protection of foreign investors, and that such interference would be highly objectionable to the United States, in view of the spirit of the Monroe doctrine. The revolutionary game as worked in Santo Domingo consisted essentially of one political party trying to oust the other from possession of the custom-houses, the revenue therefrom being the chief source of taxation in a country where there is no land-tax. The custom service of Santo Domingo was consequently by agreement placed under American control, and a large proportion of the revenue, about 60%, was impounded in New York for the purpose of liquidating foreign loans and debts, the remaining 40% going to the Dominican government for its legitimate expenses. By the suppression of smuggling and graft, this 40% soon amounted to as much or even more than the whole revenue previously collected under native management. In the meantime, the foreign debts were carefully examined and scaled down to an approximately honest basis by an American commission appointed for the purpose. Credit was thus established, and today the whole country is in a more prosperous condition than it has been for fifty years. This was American interference and domination, no doubt, but it was done quietly, unostentatiously, and will redound to the eternal good of the poor harassed people of the island, who had been for many years under the misgovernment of as corrupt a lot of rascals as can be found anywhere in the world. Conditions in Central America, Venezuela, and Colombia are, of course, not quite the same, and differ in themselves, but such differences are more apparent than real, and can no doubt be much ameliorated by this very proper missionary spirit and work on the part of the United States Government. The people of these countries are not bad, they are in the main peaceful and law-abiding, but densely ignorant, deplorably poor, with little or no incentive to accumulate property that they know by bitter experience may be taken from them by their wretched government, or become the spoil of war. No one who has not lived in these countries can realize the extent of poverty and misery caused by these miserable governments. Colombia suffers perhaps the least of all from such evils, but nevertheless as the result of recent revolutionary wars and neglect its population is probably no greater now than it was 150 years ago, and political and economic conditions in it, as in all these other Spanish-American countries, are becoming steadily worse.

It is evident therefore that a mining company to carry on its business successfully in any South American country, must be strongly and tactfully conducted, and it is especially desirable that the natives be made to realize that their country is not being exploited to their loss and detriment, but that on the contrary they share in the benefit. Hence it is desirable that there should always be some native representation on the board of management, and for that purpose a man should be selected of high character in whom the people have confidence. In Colombia I am persuaded there are a number of such persons who have kept out of politics and made their living in honest business. The interest and assistance of such men should invariably be invited by any company hoping to conduct a successful business. If this be done, foreign capital will be welcomed, and by paying due regard to native susceptibilities and peculiarities, the hearty co-operation of all classes should be secured.

Amalgaline is a metallic ribbon used for joining lead pipes or sheets. It is made from foil 0·05 mm. thick, composed of an alloy of tin with bismuth, antimony, and zinc. It is covered with a coating of stearine, vaseline, and methylated spirit, the object of the coating being to prevent the formation of oxide on the parts to be joined. It melts at a lower temperature than lead, and in making a joint the ribbon is placed between the parts and sufficient heat given to melt the ribbon but not the lead. It is stated that in the melting an alloying reaction with the lead takes place, so producing a complete junction of the two pieces of lead. In tests that have been made as to the strength of the joint, the fracture did not take place along the surfaces of junction of the two pieces.

VACUUM-CONCENTRATION AT SULITELMA

By HOLM HOLMSEN and H. N. REES

THE Sulitelma mines are situated in Norway, so far north as to be within the Arctic Circle; they adjoin lake Langvand, which is 400 ft. above sea-level, and are about 20 kilometres east of Fineidet, a port on the Saltenfjord. They were discovered about 25 years ago; since then, as a result of the enterprise of Consul N. Persson, of Helsingborg, they have been developed into an important industrial enterprise in which 1600 workmen are employed.

SULITELMA.

Though the mines are in a comparatively remote region the company has always endeavoured to keep up-to-date in metallurgical practice. It was here that the Knudsen pyritic smelting process was invented and perfected, and the plant is still in operation on a large scale. More recently the application of the Elmore vacuum process for the purpose of recovering copper from hitherto wasted tailing has attracted attention to the undertaking.

At the outset it was thought that the transport of oil and sulphuric acid for use in the plant might prove troublesome and expensive, but the point that caused most hesitation was the question of climate. However, experience of continuous work, by night and day, for a period of two years with a trial unit, and of over one year with the larger plant, has proved that these difficulties do not exist, for it is quite easy to keep the interior of the building at a temperature above freezing point.

The ore consists of cupreous iron pyrite associated with a gangue of mica schist. Some of the pyrite is found in a massive state and the rest is disseminated through the schist. The ore is sorted by hand, four grades being produced, as follows:

	Cu. %	S %
(1) Sulphur ore	3	44
(2) Copper ore	6	32
(3) Concentrating ore ..	1·8	22
(4) Waste...............	0·25	3

The first of these products is shipped to sulphuric acid makers, the second is smelted to the mines, the third is sent to an ordinary water-concentration plant, and the last is thrown over the dump.

It was known for some time that the loss of copper in the concentrating plant was high. All the usual steps were taken to minimize this loss, but without much success. The ore is one that yields a large proportion of slime, and as the copper mineral also possesses a laminated structure and therefore is liable to be washed away in a stream of water, it follows that heavy losses in the concentration mill were inevitable. An investigation was made by Henry Louis, professor in Durham University, and it was found that the loss of copper in the mill was over 40%. It was to remedy this state of affairs that tests were instituted with the vacuum flotation process. The first trials were made with a hand-testing machine on a few pounds at a time of the tailing from the jigs and tables; as the results were satisfactory, a complete unit with a capacity of about 40 tons per day was installed. This was operated continuously for two years, treating part of the current tailing, both sand and slime, from the jigs and tables. The results were substantially the same as those obtained in the laboratory experiments—a fact worth noting. Thereupon a 12-unit plant was installed. This commenced regular work in February 1909 and has been in continuous operation ever since.

The plant used in the Elmore vacuum process needs no detailed description, as it is of the usual type. There are, however, special circumstances and conditions at Sulitelma. The tailing from the jigs and tables consists of all sizes of particles from a maximum of 15 mm. down to the finest slime, all the solid matter being associated with a great volume of water. Not less than 300 litres of water per second is sent to the vacuum plant. The launder for conveying this pulp is of considerable length and is 27 in. wide by 18 in. deep. The velocity of the stream being rather high, the launder, which is constructed of timber, is lined with burnt brick. This has proved an excellent protection against excessive wear. The launder delivers into a large spitzkasten. The coarse material from the first three points is fed to three Krupp wet ball-mills; the overflow from the spitzkasten goes to a series of settling-tanks, and the overflow from these tanks goes to waste. The crushed ore from the ball-mills together with the fine from the spitzkasten and the slime from the settling-tanks are pumped to a rotary distributor, which accurately divides the pulp into the required number of equal streams, one going to each of the Elmore units. The ball-mills are fitted with $\frac{3}{4}$ mm. wire screens.

The material fed to the vacuum-concentration plant varies considerably as to quantity per hour, the amount of pyrite, and the percentage of copper. As the process recovers both of the sulphides, the grade of the concentrate necessarily varies also. The concentrate, however, is remarkably free from gangue, consisting almost entirely of clean iron and copper sulphides.

The following figures are representative:

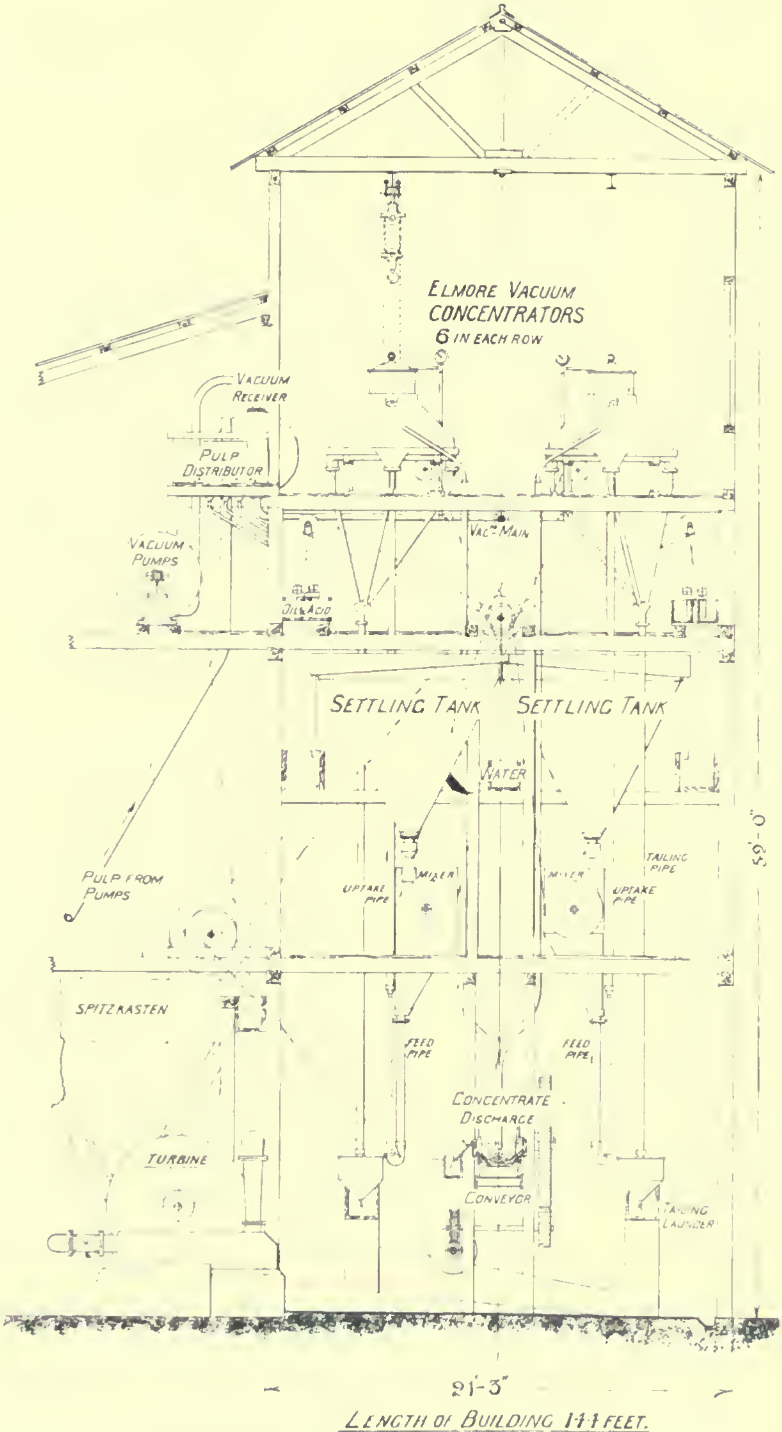
	Copper %
Tailing from jigs and tables	0·8 to 1·4
Concentrate	6·0 to 8·5
Final residue	0·15 to 0·30
Extraction	Over 80%

The consumption of oil is small, being at the rate of only 2·7 lb. per ton of material treated. The use of acid has been abandoned for some time past. Ordinary sulphuric acid was originally employed to the extent of 3·0 lb per ton of material treated. Trials with satisfactory results were also made using a solution of sulphurous acid, prepared by passing roaster-gases through water. It is doubtless a fact that a cleaner tailing is obtained when using acid, but it will be seen from the above figures that there is not much room for improvement. It does not, however, follow that this particularly favourable condition will be customary with other ores.

The plant requires little labour to operate it. It was designed to handle 500 tons per 24 hours, but this is by no means the limit of capacity. The labour employed, exclusive of that required in the crushing department, is only one man per shift of 8 hours on each floor, namely, at the separators on the top floor, at the mixers on the first floor, and at the concentrate-discharge on the ground floor.

In addition to these there is one foreman for the general supervision of the crushing department as well as the Elmore plant, on each shift, and one labourer on one shift only. Even with this small staff there is not sufficient work to keep everybody fully employed. Experience indicates that if the plant were doubled in size no more hands would be necessary.

The concentrate, amounting to about 1000 tons per month, discharges automatically on a belt-conveyor, which removes it to a bin. The construction of this conveyor allows of some draining of the concentrate, so that although it is fine and of a slimy nature, it does not carry more than 15% to 17% moisture, much of which subsequently escapes and evaporates while in



SECTION OF VACUUM-PLANT AT SULITELMA.

the bins. The final residue runs by gravity to the dump. The motive power required for the mill is supplied by a turbine working with water under a head of 460 feet.

To show the smooth running of the plant it may be pointed out that during eight months of continuous work a loss of only 25 hours was attributable to the vacuum-concentration plant, as distinct from the crushing mill, etc. Of the 25 hours lost, 9 were due to trouble with the concentrate conveyor, 4 to a breakage of the main driving-belt, and the remaining 12 hours were lost by reason of chokages caused by sudden rushes of ore to the plant.

The concentrate produced is an excellent furnace material; part is sold to copper smelters, and the balance, after being briquetted, is smelted on the spot in the Knudsen furnace.

From past working of the jigs and tables there is a large accumulation of tailing at one end of the lake in close proximity to the mill. Although this tailing has been exposed to atmospheric oxidation for a number of years, trial parcels have given a satisfactory yield in the Elmore plant and a dredging scheme is now under consideration for its recovery.

From the above figures it will be seen that the Elmore plant at these mines is recovering from 800 to 1000 tons of metallic copper per annum from material previously valueless.

SEPARATOR-FLOOR OF VACUUM PLANT.

COMPANY REPORTS

Tharsis Sulphur & Copper.—This company was organized in Scotland in 1866 to acquire pyrite mines in the South of Spain. The properties consist of the Tharsis, Calanas, and Lagunazo mines, of which the second named is now the chief producer. The report for 1909 shows that 79,432 tons of ore was mined at the Tharsis and sent to the leaching floors, a decrease of 16,131 tons compared with 1908. At the Calanas 293,643 tons was mined and sent to the floors, and in addition 15,977 tons of cupreous sterile was mined. The decrease in the output compared with 1908 was 87,030 tons. At the Lagunazo mine no pyrite was extracted, but the heaps continue to yield copper. The pyrite, including washed ore, shipped for sulphur content during the year was 418,901 tons, practically the same figure as 1908. The production of refined copper was 4357 tons as compared with 4427 tons in 1908. The profit at the mines for 1909 was £179,760, and £28,853 was received as interest on investments, while income-tax, cost of administration, and depreciation absorbed £49,847. The distribution to shareholders was £156,250 being at the rate of 12½%, the same as last year. Since the commencement of operations gross profits amounting to £13,012,200 have been made, out of which £1,288,502 has gone toward taxes and management, £2,458,499 has been written off property and plant, and £9,224,682 distributed as dividends. In the balance sheet the property and plant stand at a purely nominal figure and the cash and securities amount to £1,022,300, so that the nominal capital £1,250,000 is now mostly represented by cash. It is the intention of the directors to re-apply this capital to mining operations whenever a suitable opportunity offers. The company's engineers have examined numerous properties but so far with no result. An option was acquired in Arizona in 1908 but was subsequently abandoned.

International China-Clay Corporation.—This company has been formed to acquire the china-clay business of Frugier & Co. at Plemet, Brittany, France, and of the International China-Clay Co. of Paris. The Plemet china-clay is of high quality and is used by makers of porcelain at Limoges and Sevres. Clay for white-face bricks and fire-bricks is also produced. The Paris company recently acquired properties in Cornwall and floated them as the St. Austell China-Clay Works Ltd., as noted in our March issue. W. Marshall Grose is the managing director of the new company, and Shrew & Sons are the promoters. The capital is £200,000, of which £65,000 in shares and £47,000 in cash is the purchase price. The working capital raised by the present issue will be £23,000 of which £13,000 will be spent in erecting new plant. The remaining 60,000 shares are held in reserve.

Gold Schists of Rhodesia.—This company has been formed by the Rhodesian Exploration & Development Co. for the purpose of developing a number of claims situated in the Enterprise Schist goldfield, 25 miles from Salisbury. At one of the properties, the Arcturus Reef, mining and milling has been carried on until recently and 9222 tons yielded 4253 oz. Since then development has been advanced actively. At the Slate mine also milling operations have been conducted by a small mill, recovering 3071 oz. from 3127 tons, and work on a small scale has also been done on the Huguenot, Grand, Mafuta and other claims. The capital of the company is £750,000 of which £500,000 in shares go to the vendors and 200,000 shares have been subscribed at £2 each. The prospectus does not mention the name of any engineer.

Esperanza.—This company, floated in 1903, owns the stock of the Esperanza Mining Co. registered in New Jersey, which owns and works the gold mine in the El Oro district, Mexico. The board of directors includes the name of R. J. Frecheville; Pope Yeatman is consulting engineer to the American company, and Charles Hoyle is manager at the mine. The report for 1909 shows that 177,702 short wet tons of ore was treated, as also were 34,768 tons of dump-tailing. The value of the gold, silver, and lead recovered was £429,630. Of the ore 31,954 tons was sulphide; this was concentrated, the concentrate being sent to the smelter and the tailing to the cyanide plant. The oxidized ore, amounting to 129,255 tons, was treated by cyanide as also was the dump-tailing. No amalgamation is done, and cyanide solution is used in the battery. The new mill started in June and the old mill has gradually been overhauled and re-constructed. The report does not give the separate production of gold and silver. The total mining and milling cost was £270,061. It is noteworthy that the gross value of the ore is less than in the year previous, the figures in the report being given as \$10.44 per dry metric ton for 1909, and \$14.75 for 1908. The profit per ton in 1909 was \$3.71 and \$5.50 in 1908, and the operating cost was \$6.78 in 1909 and \$7.25 in 1908. The ore reserve is given at 227,578 tons and the developments are proceeding in a satisfactory manner. The profit of the American company for 1909 was £161,646, and the English company has distributed £108,857 as dividend, which is at the rate of 25% on the paid-up capital.

Mason & Barry.—This company owns the San Domingos copper and sulphur mine at Mertola, Portugal. The mine is situated only a mile or so from the Spanish border and is situated on the line of pyrite deposits usually identified with the Rio Tinto. The company was formed in 1878, and paid excellent dividends from the start. Towards 1892 the yield was less, and during recent years the limits of the deposit have been known. Instead of writing off amounts for depreciation of the property every year and accumulating a large capital reserve fund, as has been the policy of the Tharsis, the directors of Mason & Barry have from time to time returned capital to shareholders and reduced the denomination of the shares accordingly. The issued capital of the company consists of 185,172 shares which are now £1, as compared with £5 fifteen years ago, and £740,688 has been distributed in cash to shareholders as a return of capital, while concurrently over one million pounds has been paid as dividend. The report for 1909 shows that 308,987 tons of ore was mined during the year. The profit on the sale of sulphur ore and copper was £30,934 which added to the balance brought forward leaves a distributable balance of £55,684, from which a dividend of 25% absorbing £46,293 has been paid. The company has a reserve fund invested in high-class securities amounting to approximately £100,000. The present report does not give any information as to the life of the mine, but it is probably limited to two or three years.

Bucks Reef.—This company was formed on May 1, 1909, to acquire the mine and its equipment in the Gwanda district of Rhodesia. The company is in the Neumann control, S. C. Thomson is consulting engineer, and James Black is manager. The equipment hitherto used consists of two Tremain stamps. During the eight months to the end of December, the mill treated 4082 tons of ore and produced 7532 oz. gold, of which 6181 oz. came from the stamps and 1351 oz. from the sand-plant. A new plant consisting of 5-stamps each weighing 2000 lb. has almost been completed, and within a short time it will supersede the old mill, which is inconveniently situated at some distance from the mine. The veins at Bucks Reef and at Prestwood, which also belongs to the company, average 30 in. in width, and the developments at various parts show ore varying from 19 to 100 dwt. The main shaft at Bucks Reef is down 584 ft. and at Prestwood the shaft is down 294 ft. The ore reserve on December 31 was 8061 tons, with a value of 30·8 dwt. over 30 in. During the eight months covered by the report the sale of gold brought an income of £31,548, while mining, milling, and development cost £10,570, administration £1596, and royalty to the Chartered Company £1483. There was therefore a balance of profit of £17,899, out of which a dividend of £15,000 at the rate of 12½% on the paid-up capital £120,000 has been distributed.

Globe & Phœnix.—The report of this Rhodesian company for the year 1909 contains much interesting information relating to the recent discoveries of rich ore, which have already been described in our columns. The ore reserve at the end of December 1909 was 171,507 tons, averaging 31¼ dwt. per ton, with a gross value of £1,124,878, as compared with 144,348 tons, with an average of 16 dwt. and gross value of £485,020. The profitable ore extends to a greater length on the 15th level than on the 14th and 13th, the actual lengths being 1923 ft., 1315 ft., and 1230 ft. respectively. Work on the 16th level, below the dike, disclosed the remarkably rich ore ; the south drift is 208 ft. long and assays 37·7 dwt. over 31½ in., and the north 212 ft., assaying 157 dwt. over 32 inches. The average of the orebody on the 16th level is 64·6 dwt. over 31·8 in., as compared with 28·9 dwt. over 37·9 in. on the 15th level. The 17th level is opening well, for on the south drift, which is 102 ft. so far, the orebody assays 28·6 dwt. over 30 in. The north drift has not yet been commenced and the work promises some eager expectations.

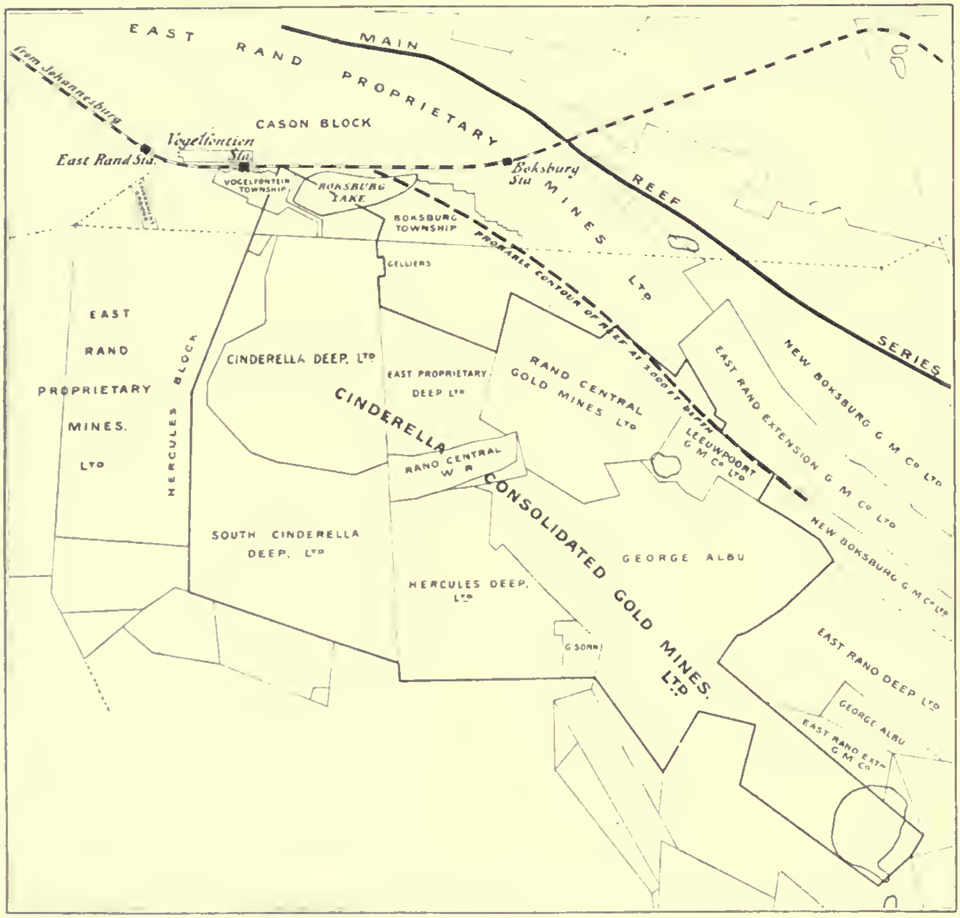
During the latter half of the year some of the high grade ore was sent to the mill, so that the output and profit have been substantially increased. The amount of ore crushed in the 40-stamp mill was 74,492 tons and the yield was 59,306 oz. The sand-plant treated 44,268 tons and recovered 4357 oz., while 23,861 tons of accumulated and 4950 tons of current slime yielded 2840 oz. The total production was therefore 66,503 oz., or 17·85 dwt. per ton. The working cost, including mine development, was 28s. 2d. per ton, which is an increase of 2s. over 1908, chiefly due to the fact that the machinery is old and requires much expenditure to keep it up to the mark. The total revenue was £283,882, and the expenses and allowance for depreciation £133,236, leaving a profit of £150,646. The year commenced with a balance in hand of £47,802, so that the amount available for distribution was £198,448. Out of this, £160,000 has been distributed as dividend for 1909, being at the rate of 80% on the capital. The £1 shares now stand in the market at £8. In our issue of October last we referred to the difficulty of treating this ore by cyanide owing to the presence of antimony. The present report states that the new plant for the improved treatment designed by H. T. Brett is being erected and should be at work in May. In the above figures relating to the extraction by the sand-plant it will be seen that the yield was only 2·33 dwt. The assay-value of the charge was 7 dwt., so that 4·67 dwt. was left in the residue. The new plant will not only treat current sand and slime but also the old residue and accumulated slime.

Bwana M'Kubwa Copper.—This company has been formed as a subsidiary of the Rhodesia Copper Co. for the purpose of financing the copper mine in Northern Rhodesia. The capital is £600,000 in 1,200,000 shares of 10s. each. Of these 166,666 go to the British South Africa Co., 33,334 to the Northern Copper (B.S.A.) Co., and 300,000 to the Rhodesia Copper Co. along with £50,000 in cash, as purchase consideration. In the present flotation 350,000 shares are being offered to the public for subscription ; of these 116,666 have been underwritten by the British South Africa Co., and the remainder by L. Hirsch & Co. The latter have a call for two years at par on 175,000 shares. The prospectus does not give any details of the work to be done at the mine with the working capital provided by this flotation, but it is stated that the reserve consists of 120,000 tons of ore assaying 14% copper, in addition to large amounts of lower grade ore with an average value of 5%. Three levels at depths of 100 ft., 250 ft., and 350 ft. have been driven 1577 ft., 1764 ft., and 275 ft. respectively, and the main shaft is down 358 ft. The mine as has already been mentioned in our columns is situated on the railway and is about 100 miles south of the property of the Tanganyika company. The board of directors of the Bwana M'Kubwa company contains the names of Thomas Huntington and Alexander Stewart.

London and Rhodesian Mining and Land.—This company was formed in May 1909 by Julius Weil & Co. to acquire a number of mining and other properties in Rhodesia. Owing to the successful development at the Cam and Motor mines, 100,000 new shares are now being offered to the public at 35s. per share, and the whole of this issue has been underwritten. The money so obtained will be used in completing the purchase of these two mines and in further development and providing equipment. The prospectus does not give any details of the work done at the mines.

Mount Boppy.—This company was formed by John Taylor & Sons in 1899 to acquire the Mount Boppy gold mining property in the Cobar district, New South Wales. At the same time the 40-stamp mill, pumping and winding plant, and other equipment belonging to the Gallymont Gold Fields Limited were purchased. In 1904 an additional 20-stamps were erected making 60 in all. Milling commenced in June 1901, and the first dividend was paid in 1902. During the years 1904 to 1908 the mine did well, paying 47½% per annum on a capital of £121,000. The report for 1909 just issued shows that the mine has recently been yielding ore of lower grade. The amount milled was 70,334 tons yielding 10,446 oz. fine, as compared with 69,557 tons yielding 11,981 oz. fine in 1908. The yield of gold from sand was 8147 oz. from 45,540 tons, and from slime 5757 oz. from 21,834 tons. In addition 2409 oz. was recovered from 436 tons of concentrate and 2113 oz. from roasted sulphide residue. The total production for 1909 was therefore 28,902 oz., a yield of 8¼ dwt. per ton. The yield in 1908 from mill and cyanide plant, and from concentrate and residue was 34,136 oz. or just 10 dwt. per ton. The realized value of the output was £120,994 and the total income £121,539. The working cost was £76,128 ; £4000 was allowed for depreciation ; £2330 spent on surface and mine works, etc. ; £350 extra grant to staff ; £4859 for income-tax. Including a balance of £484 brought forward at the beginning of the year, the disposable profit was £34,335, out of which £33,275 has been paid as dividend at the rate of 27½%, as compared with 47½% during 1908. With regard to the future, it would appear that the drop in the output is only temporary, for the monthly returns since the close of the year show an increased yield once more. It is reported that the development at the 5th or lowest level is most gratifying and that in the 200 ft. level in a hitherto less developed part of the property an extensive and valuable orebody has been found. The reserve has been substantially increased during the year and now stands at 225,500 tons or 3 years supply. Judging by the quality of the recently developed ore there should be no difficulty in restoring the yield to the old figures, 10 to 11 dwt. per ton. It is gratifying to find also that the mining and milling costs have been reduced from 24s. to 20s. per ton during the year.

Cinderella Consolidated.—Another large amalgamation of mining properties in the eastern portion of the Rand has been effected by the formation of the Cinderella Consolidated Gold Mines Co. The consolidation consists of the purchase by Cinderella Deep during 1909 the output of gold was 54,281 oz. from 157,548 tons, the yield being 29s. 3d. per ton. On December 31, the reserve of ore blocked out was 263,300 tons with a value of 7·3 dwt., in addition to which large blocks of low-grade ore are known to exist. By a careful study of the remaining tract brought into the amalgamation, but without definite information derived by boreholes, an estimate is made that the possible contents of the tract will be 50 million tons having an average value of 27s. 6d. It is also estimated that when working on a larger scale the average contents may be reduced, but that the profit per ton will never be less than 10s. At the present



of the properties lying to the east and south belonging to the Rand Central Gold Mines, Leeuwpoort Gold Mines, South Cinderella Deep, East Proprietary Deep, Hercules Deep, and a further tract held in the name of George Albu, together with a few smaller areas belonging to various owners, the total area covering about 3000 acres. These properties belong to the General Mining & Finance Corporation, or Albu, group. They are situated to the south of the other great consolidation, the East Rand Proprietary, belonging to the Farrar group. The Cinderella Deep is the only property of the group that is now producing, and it is practically the deep level of the Cason portion of the East Rand Proprietary. Milling started in 1908, and time the metallurgical plant consists of 100 stamps weighing 1650 lb. each, together with two tube-mills and cyanide plant. The shaft now in operation will be used for the development of the western portion of the combined area, and a new 7-compartment shaft will be sunk in the Rand Central block for the purpose of opening up the central part of the tract. Eventually another shaft is to be sunk farther to the south-east. When the central shaft is sunk, it is intended that the output shall be 100,000 tons per month, and when all three are in operation the output will be 200,000 tons per month. The capital of Cinderella Deep is £500,000, and that of the new company will be £1,500,000 in shares and £500,000 in 5½% debentures. Of the shares 500,000 will be issued to shareholders in Cinderella Deep, 409,450 will be issued as purchase price of the other property, 250,000 will be sold for cash at £2 per share, while the remainder will be held for the exchange of debentures and other purposes. Of the cash raised by the sale of shares and debentures, £222,350 goes as further payment for properties absorbed. After adjustment of capital owned by the individual companies, the consolidated company will have approximately £680,000 in hand for working capital. The exact site of the new mills has not been fixed; instead of extending the present mill it is probable that the extra plant will be built near the mouths of the central and southeast shafts.

Sons of Gwalia.—This company was formed in 1898 to acquire mines near Mt. Leonora in the North Coolgardie goldfield, West Australia. Bewick, Moreing & Co. are the managers, and John McDermott is superintendent. The ore is not now of so high grade as six or seven years ago, but by more efficient metallurgical work and by reduction of expenses, the profit is not much less than it was in 1903-4-5. In addition the mine is developing at present in a satisfactory manner, the reserve of ore is increasing, and a new lode called the West has been discovered. During the year 1909 the 50-stamp mill treated 159,057 tons of ore which yielded 38,932 oz. by amalgamation; the cyanide plant produced 9657 oz. from sand and 5317 oz. from slime; 6661 oz. was produced from concentrate, and 384 oz. and 148 oz. from accumulated slime and slag. The total production was therefore 61,099 oz. which realized £259,608, a recovery of 32s. 7½d. per ton. The cost of mining, milling, and development was £163,257, or 20s. 6d. per ton. The directors have written off £8509 for depreciation, have allowed £6434 for taxes, and have placed £15,000 to reserve. The dividend distributed is £65,000 or at the rate of 20%. The ore reserve has been steadily increasing and now stands at 3¼ years supply. The main shaft is down to 2344 ft.

Premier Diamond.—This company was registered in 1902 to operate the deposit north of Pretoria in the Transvaal. The Government takes 60% of the distributed profits, after which 160,000 preferred shares of 5s. take a dividend of 250% and 320,000 deferred shares of 2s. 6d take the remainder. The deferred shares have up to the end of 1909 received three dividends of 400% each and one of 200%. The mine is remarkable for two reasons, first for the discovery of the Cullinan diamond, and second for its enormous output of low-grade ground. It is worth while noting that during the recent collapse of the diamond market, the output was not appreciably curtailed, a policy differing essentially from that of De Beers; also that the ground is not weathered on floors but broken in crushers. The report for the year ended October 31, 1909, shows that 7,708,755 loads (each 16 cu. ft.) was mined and washed and the yield was 1,872,136 carats, or ¼ carat per load. The mining and washing cost was 1s. 10d. per load or 7s. 5d. per carat. The income from the realization of diamonds during the year was £1,454,917; the diamonds on hand at the beginning of the year were valued at £595,847 and at the end £355,297; so that the amount placed to the credit of the diamond account for the year was £1,172,378. The mine cost was £694,299 and the cost of administration brought the total expenditure to £733,567. There was therefore a balance to credit of £438,811. The dividend distributed during the year was only £100,000, which went to the preference shares, but a dividend of £80,000 or 200% on the deferred shares was declared after the close of the year, in December. The methods of realizing the diamonds and of valuing stock not being disclosed, the details of finance of the company are not made clear in the report. Preparations are being made for a still further increase in the output, and before long 1,000,000 loads of ground will be mined every month. At this rate it is estimated that there is 30 years in reserve above the 1500 ft. level.

Ivanhoe.—The Ivanhoe mine is in the centre of the Golden Mile at Kalgoorlie and is surrounded by the Horse-Shoe and the Great Boulder Proprietary. It was one of the Whitaker Wright flotations, having been purchased by the present company in 1897 from the Melbourne owners. After the collapse of the Wright regime, Bewick, Moreing & Co. became consulting engineers. Large profits have been made since the beginning and dividends amounting to £2,470,000 have been paid by the English company; during the same time the output of gold has been 1,310,908 oz. fine, valued at £5,587,674. At present the position is that the lode has been cut at the lower levels, 1970 ft. and 2120 ft., and although the content is low at the point of intersection, at the 1970 ft. level it increases as the level is continued and at one point some valuable ore has been cut. The ore reserve above this level amounts to over one million tons with an average assay-value of 45s. 8d., which is an increase of 73,700 tons during the year and a decrease of 4s. per ton in value. During the year 1909, the ore sent to the 100-stamp mill was 231,063 tons. By amalgamation gold valued at £137,586 was obtained; 21,051 tons of concentrate was roasted and cyanided yielding £122,082; 104,218 tons of sand yielded £67,874; and 105,794 tons of slime gave £171,710. The total extraction was therefore £499,253, and the percentage of recovery was 88·3, which is an improvement of 1·53% over 1908. The question of increased extraction is closely studied, and one of the improvements made during the year is the introduction of aeration of the roasted concentrate before agitation with cyanide. Also a screening apparatus has been introduced to eliminate the fine before the ore is sent to the grinding-pans. The cost of treatment was £241,549, which includes development, mining, extraction, and general expense. This is at the rate of 20s. 11d. per ton, and is practically the same as during 1908. After paying London expenses, taxes, etc., the divisible profit was £248,583, out of which £240,000 has been distributed as dividend. It is worth noting that altogether £759,353 has been written off the expenditure on development, plant, equipment, etc., and that the company has a reserve fund of £208,499 invested in first-class securities, mostly debentures of English railways.

Ooregum.—This is one of the group of gold mines in the Kolar district of India managed by John Taylor & Sons. The company was formed originally in 1880 and reconstructed in 1885. Production commenced in 1888 and dividends in 1891. Though not as large a producer as Mysore, Champion Reef, and Nundydroog, the mine has done well, and the total dividends distributed up to the end of 1909 have amounted to £1,715,355. The average content of the ore mined has periodically shown decreases. One such period of depression occurred during the years 1905-7 and the dividend paid for 1907 was only £38,353. Since then the grade has improved and during 1909 it was 12½ dwt. as compared with 8¾ dwt. in 1905. The report for 1909 shows a distribution of £120,231 and the general position is decidedly encouraging. The amount of ore crushed was 125,349 tons and the yield in the battery was 79,181 oz. bullion. In addition 114,748 tons of tailing was cyanided and yielded 12,677 oz. bullion, and 5378 tons of slime was treated in an experimental plant, yielding 205 oz. The total production of gold was 82,346 oz. fine, an increase of 5811 oz. over 1908. The gold realized £349,012 and the working expenses were £184,493; other small items in income and expenditure left a profit for the year of £151,973. Out of this £5866 has been paid as income-tax, £27,894 has been written off capital expenditure, and £120,231 has been paid as dividend, as already mentioned. This dividend corresponds to 40% on the 240,000 preference shares of 10s each and 30% on the 481,544 ordinary shares of similar denomination. In the report the directors mention that the original lease for 30 years has just expired and that the company entered upon the new lease on March 22 The working expenses will show a marked decrease during the current year, as the cost of power supplied by the Madras Government's electric generating station at the Cauvery falls has been lowered from £24 to £10 per horse-power per year. The directors also refer to the advantages obtained by the new Bullen's shaft, illustrations of which we give herewith. As regards reserve, the figure on December 31 was 157,582 tons, an increase during the year of 3300 tons. Some rich ground has been proved to extend to the lowest workings, 3810 ft., and the continuity of this shoot is highly encouraging for the current year's prospects.

Head-frame at Bullen's Shaft, Ooregum.

Balaghat.—This mine is the most northerly of the Kolar group managed by John Taylor & Sons and the orebodies have never been so 'kindly' as those at the southern end. Since the formation of the company in 1886, there have been three reconstructions and it was not until 1900 that dividends were paid. Subsequently the output and profit were gradually increased until in 1905 and 1906 dividends of £55,000 were distributed. In 1905 the output realized £164,203 and in 1906, £178,898. Since then the output has seriously fallen and the report for 1909 is far from encouraging. During the year 7136 ft. of development work has been done, with only disappointing results. On December 31, the reserve was 29,353 tons. During the year 37,350 tons of ore was milled producing 18,285 oz. bullion, and 54,970 tons of tailing yielded by cyanide 2918 oz. The total gold realized £81,028. The battery worked at only two-thirds capacity. It is proposed to continue at the present rate, about 3000 tons per month, but if development results do not improve, the position of affairs will have to be seriously reconsidered.

Durban-Roodepoort.—This is a mine situated in the western end of the Rand just east of the stretch of broken country between the so-called west Rand and far-west Rand. The company was formed in 1888 and dividends have been paid regularly since 1889. At first a 20-stamp mill was used; this was subsequently increased to 70 stamps. In 1895 an entirely new mill of 60 stamps was substituted and 30 stamps have since been added. The company is not controlled by any of the great houses. H. Ross Skinner is general manager. The report for 1909 shows that, after sorting out 11% waste, 161,812 tons went to the battery, where 35,974 oz. was extracted; 116,701 tons of sand gave 12,256 oz. and 46,424 tons of slime gave 2526 oz.; cyanide slag, etc., yielded 204 oz.; the total being 50,946 oz. or a recovery of 6·3 dwt., equivalent to 92½%. The total receipts were £215,578, and the cost of mining and milling was £105,965. In addition, local and London administration absorbed £19,426, taxes £12,679,

Three-deck Cage at Oakley's Shaft, Ooregum.

and depreciation £4103. The balance of profit was £75,574, out of which £68,750 has been distributed as dividend, being at the rate of 55% on the capital £125,000. Since the commencement of operations the total dividends have amounted to £1,203,800 or 980% on the capital. On December 31, the reserve of ore was 1,007,000 tons, most of which was on the Main Reef. The life of the mine will be short after this reserve has been exhausted. During the past year a new sorting plant was put in operation. The main incline shaft is showing signs of age and the effect of the overlying weight of rock; exceptional expenditure will have to be devoted to putting it in a condition to last for the rest of the life of the mine. The old pumps also had outlived their usefulness, but instead of spending money on a new installation, the company has made an arrangement with the Durban Roodepoort Deep, one of the Wernher-Beit group, whereby the installation at the latter mine has been increased sufficiently to cope with the water from both mines. For this service the company will pay a monthly rate.

Arizona-Morenci Copper.—The shares of this company, which is incorporated under Arizona laws, have been introduced in London. The company owns copper-bearing claims in the midst of the Clifton-Morenzi district and adjoining those belonging to the Arizona Copper Co. and Phelps, Dodge & Co. The capital of the company is $10,000,000 divided into 1,000,000 7% participating preference shares and 1,000,000 ordinary shares, both of $5 each. Half of the preference shares are now being offered for sale at 21s. each. The funds received will be used in further development and for the erection of a smelter to treat 1000 tons per day. It is stated that copper can be produced at 8½ cents per lb. No engineer's report is quoted in the prospectus and the information given is indefinite.

Robinson Gold.—The Robinson is one of the old mines of the Rand, operations having been commenced in 1887. Since 1889 the nominal capital has been £2,750,000 in 550,000 shares of £5 each and dividends have gradually risen from 5% in 1889 to 30% in 1908 and 1909. The mine belongs to the Wernher-Beit group; until this month W. W. Mein has been consulting engineer, being now succeeded by H. Stuart Martin. The report for 1909 shows that 665,962 tons was mined; 115,106 tons of waste, or 17%, was removed averaging 0·56 dwt., and 550,176 tons sent to the mill. The gold recovered in the battery was 207,935 oz., an extraction of 7·56 oz. per ton, and 4·19 oz. was left in the tailing. After re-grinding in tube-mills, 265,464 tons of sand and 168,500 tons of slime were sent to be cyanided. The assay-value of the sand was 5·03 dwt. and of the slime 2·51 dwt. The yield from the sand was 78,512 oz., an extraction of 4·3 dwt. per ton, leaving 0·85 dwt. in the residue; and the yield from the slime was 19,055 oz., or 2·26 dwt. per ton, leaving 0·26 dwt. in the tailing. The total yield in the battery and the cyanide plant was 305,503 oz. valued at £1,286,048, or 11·1 dwt. or 46s. 9d. per ton, the actual extraction being 94·5%. The cost of mining and development was £191,617 or 6s. 11½d. per ton milled, the cost of treatment £122,363, or 4s. 5d. per ton, and the administration expenses £31,156, or 1s. 2d. per ton, bringing the total working cost to £345,136, or 12s. 6½d. per ton. The working profit was therefore £940,911, or 34s. 2½d. per ton. Out of this, £825,000 was paid as dividend and £93,628 transferred to capital expenditure account. The working expense was identical with that of the previous year, while the extraction was 4s. 11d. less, owing to some of the lower grade ore of the Main Reef being sent to the mill. As regards the ore reserve, the total developed on the Main Reef Leader and the South Reef amounted to 1,940,000 tons, equal in value to the ore treated during the past year; in addition there is over 2¾ million tons on the Main Reef averaging 4·4 dwt. per ton, which can now be reckoned as profitable ore. During the past year 40 additional stamps have been erected and they started operations in November. The report mentions the experimental work in connection with the filling of the stopes with tailing. As the results were satisfactory, arrangements are being made for the general adoption of the system throughout the mine. This will make it possible to extract most of the pillars left behind, and will also assist in reducing the cost of working the low-grade Main Reef.

A statement containing a summary of results from the commencement of the company to the end of 1909 is included in the report. The total gold recovered amounted in value to £13,368,316; the expenditure on machinery and plant has been £987,624; the working costs have been £4,591,712; Transvaal taxes have absorbed £453,223; and dividends totalling £7,394,687 have been distributed. A noteworthy fact in connection with this company is that though the ore treated in the mill is rich compared to that at other mines, the working costs are as low as any on the Rand. It is not usual for rich mines to worry about small details of cost. In the case of the Robinson the incentive has been supplied by the presence of large reserves of ore in the Main Reef of far lower grade than that hitherto mined and milled.

Golden Horse-Shoe.—This mine is at the southern end of the Golden Mile at Kalgoorlie. J. W. Sutherland is general manager. The report for 1909 shows that 263,361 long tons of ore was sent to the 150-stamp mill where 39,135 oz. gold was recovered; subsequently 18,609 tons of concentrate was roasted and cyanided yielding 37,437 oz. gold; 51,574 tons of sand was cyanided and yielded 8155 oz.; while 193,178 tons of slime yielded 52,828 oz. In addition 12,751 tons of tailing was re-treated producing 3003 oz., and cyanide slags yielded 2165 oz. The total production of gold was therefore 142,723 oz. The percentage of extraction excluding that from re-treatment was 87·7, and the average extraction per ton was 46s. The income from the sale of gold was £606,316, and the items of cost were as follows: Mining £135,225, extraction £148,661, maintenance, plant, etc. £17,134, development £28,212, management £13,524, London expenses £7233, duties and taxes £13,868. The balance of profit was £242,870, out of which £240,000 has been distributed as dividend. Since operations commenced in 1899 the output has been 1,746,751 oz. from 1,904,235 tons of ore and £3,000,000 has been distributed as dividend. It is noteworthy that practically the whole cost of mine-development and machinery has been provided out of income, the figures being £319,171 and £500,059 respectively; also that the content and cost have both been greatly reduced. In 1902, 122,019 tons yielded 193,677 oz. at a cost of mining and milling of 55s. per ton; in 1909, 263,361 tons yielded 142,723 oz. at a cost of 22s. 9d. Costs might still further be reduced and an intimation that this will be so is given in the current report. It is necessary to guard against superficial comparison with adjoining mines where the short ton is used. As regards ore reserve, the report shows that on December 31 it amounted to 1,071,638 long tons averaging 11 dwt., a figure practically the same as at the beginning of the year. The reserve is only calculated to the 1650 ft. and 1767 ft. levels on the two chief lodes; these lodes have proved to go down to 2000 feet, but the developments are not sufficiently far forward to warrant any estimate of the ore in the lower part. In addition the adjoining mine on the eastern boundary, the Great Boulder Proprietary, has proved to 2600 ft. a lode that passes into the Horse-Shoe, so altogether the prospects for the future are good.

Mountain Copper.—This company was floated in 1896 by Matheson & Co. for the purpose of acquiring the Mountain mine, situated at Iron Mountain, Shasta county, California, together with smelting works at Keswick and a refinery in New Jersey. Subsequently the Keswick works were closed and operations were transferred to Martinez on San Francisco bay. For some years the output of copper was large, but subsequently the deposit was found to be limited. The company was therefore reconstructed in 1902, the share capital being exchanged for redeemable debentures. The report for 1909 shows that the output of copper has still further fallen, being 1254 tons as compared with 1838 tons in 1908, and 13,270 in 1901. The profit for the year was £24,557, which is not sufficient to pay the 6% interest on the £750,000 debentures outstanding; but it has been paid out of the large cash balance in hand, approximately a quarter of a million pounds, a balance held over from the days when the mine was more profitable. The chief business of the company now is the manufacture of sulphuric acid and fertilizers and most of the ore is mined for its sulphur content, coming from the Hornet property. The copper output for 1909 was produced by smelting the spent pyrite mixed with some of the ore still found at the Mountain mine. During the year exploration work has been conducted, absorbing £10,067, which has been charged to capital. One of the drifts has encountered higher grade ore but its extent has not yet been ascertained. Lewis T. Wright is the manager.

Alaska Mexican.—This mine belongs to the Treadwell group on Douglas Island and is under the same control and management as the Alaska Treadwell and Alaska United. The company was formed in 1892 and crushing commenced in 1894. The report now issued covers the year ended December 15, 1909. During this period 226,651 tons of ore was treated in the 120-stamp mill and gold valued at $470,852 was recovered by amalgamation; in addition, gold worth $376,854 was obtained from sulphide concentrate, or $1·66 per ton; thus the total production was $847,706 or $3·74 per ton. The mining and development cost was $277,086 or $1·22 per ton; milling, $55,109 or 24 cents per ton; cost of treating sulphides at Tacoma, $28,378 or 12½ cents per ton. Administration and other expenses brought the cost to $383,704 or $1·69 per ton, leaving a profit of $468,424 or $2·06 per ton. Out of this $360,000 has been distributed as dividend and $100,000 written off for depreciation of plant. During the year most of the ore milled came from the 770 ft., 880 ft., 990 ft., and 1100 ft. levels, and stoping operations were centred on the 990 ft. and 1100 ft. levels. On December 15, the ore reserve was 596,404 tons of which 201,000 tons was ore ready broken in the stopes. The main shaft has been sunk to 1470 ft. and levels have been commenced at 1320 ft. and 1400 ft.; the lode is continuous to this depth but sufficient work has not been done at these levels to warrant the ore being included in the reserve.

Treadwell, Alaska.

Alaska United.—This company belongs to the group of Treadwell mines on Douglas Island, Alaska, controlled by the estate of the late D. O. Mills and having its head office at San Francisco. F. W. Bradley is a director and the consulting engineer, and Robert A. Kinzie is superintendent. This company owns the Ready Bullion and 700 ft. Claim mines, and was formed in 1895. The present report covers the year ended December 15 at the mine, and December 31 at San Francisco. At the Ready Bullion mine 227,710 short tons of ore was mined and milled. The yield of gold in the battery was valued at $278,868 or $1·2247 per ton, and from the sulphide concentrate shipped to Tacoma $215,359 or $0·9457, making a total yield of $494,227 or $2·17 per ton. The mining cost was $257,447 or $1·13 per ton, the milling and concentrating cost was $86,970 or $0·38 per ton, a total of $1·56 per ton. The working profit was $138,354 or $0·61 per ton. The ore reserve on December 15 was 1,116,650 tons. At the 700 ft. Claim mine, 190,474 tons was mined and the mill treated 184,799 tons, yielding gold worth $265,608 in the battery and $224,084 in sulphide concentrate. The yield per ton was $2·65 and the cost of mining and milling $330,466 or $1·78 per ton. The reserve on December 15 was 536,069 tons. The total profit for the year from the two mines was $261,743, and $234,260 has been distributed as dividend, which is at the rate of 26% on the capital of the company.

Taxco Mines of Mexico.—This company has been formed to acquire the old Rosario silver mine in the district of Taxco, State of Guerrero, Mexico. The properties have been recommended by T. R. Marshall and the economic geology and general prospects have formed the subject of a report by Ezequiel Ordonez. The oxidized silver ore of the district was worked successfully by the patio process in past years, but the sulphides were not amenable to this treatment and operations were suspended. During recent years the use of fine grinding and cyaniding has proved successful on similar ore in other parts of Mexico, and the intention is to apply this treatment here. A plant to treat 90 tons per day is to be erected. The veins consist of quartz containing silver sulphide with some gold. The ore that is left in the old stopes averages 20 oz. silver and 1 dwt. gold per ton. The richer bunches and stringers have been extracted by previous workers and sold to smelters, and there is every reason to suppose that when development work is undertaken in virgin ground that similar rich patches will be found. The capital of the company is £60,000 divided into 240,000 shares of 5s. each; of these 120,000 go as purchase price to the vendors and 80,000 are being offered for subscription, the remainder being retained for future issue. The promoters are C. W. Whittemore, director of the local company, and L. T. Boustead and D. J. L. Anderson, of London. This is an interesting proposition and the capitalization is reasonable.

Princess Estate.—This company was formed in 1888 to acquire an outcrop mine in the west Rand, adjoining the Durban Roodepoort. Operations commenced in 1892 with 30 stamps which were subsequently replaced by new plant now consisting of 60 stamps. During 1909, the tonnage mined was 161,941 tons, from which 49,030 tons of waste or 30% was removed by sorting and the remainder sent to the mill. The actual amount milled was 113,679 tons averaging 8·88 dwt., and the yield was 30,044 oz., an extraction of 5·29 dwt. In addition 6369 tons of concentrate yielded 5071 oz., 69,869 tons of sand yielded 9091 oz. and 22,091 tons of slime 1452 oz. As the new slime-plant only commenced operation in July the extraction was not at its full pitch. The total production of gold was 46,097 oz. valued at £194,824, a yield of 8·11 dwt. or 34s. 3d. per ton. The working cost, including development, was £140,818, and administration and taxes absorbed £4939, while there was a further revenue from various sources amounting to £4780. The dividend was £53,000 or 20% on the capital, which is approximately 9s. 6d. per ton milled. The mill did not run at its full capacity owing chiefly to the influx of water in the earlier part of the year. The yield was 1·1 dwt. less than during 1909. The development charges at this mine are necessarily higher than at others on the Rand as the deposit is fractured and the content is irregular. It is only recently that the company has made profits, in fact the dividend for 1909 is more than half the total dividends ever distributed. The control is in the hands of the Goerz group; W. M. Cameron is consulting engineer, and L. A. Womble is manager.

Meyer & Charlton.—This mine is in the central part of the Rand and belongs to the Albu group. Operations commenced in 1888 with 30 stamps and the equipment was gradually increased until 75 stamps with cyanide plant and tube mills are now working. The original ground is practically exhausted, but by a recent agreement with the Government additional mining rights have been acquired that will add a further 18 years to the life of the mine. During 1909, the ore mined was 178,775 tons, of which 11½% was discarded as waste, and 157,943 tons sent to the mill. The yield of gold in the battery was 14,532 oz., and the cyanide plant produced 37,427 oz., the total being 51,959 oz. The assay of the mill-ore was 7·27 dwt and of the residue 0·52 dwt., a recovery of 92·7%. The working cost per ton was 17s. 3½d., and the yield 27s. 10d. per ton, leaving a profit of 10s. 6½d. The cost includes everything but taxes. The income from the sale of gold was £219,821, and the expenses £136,557, and taxes £10,298. Out of the profit, dividends amounting to £65,000 were paid. As above-mentioned, the extra area recently acquired has added to the life of the company. The extended property requires additional accommodation in the way of shafts and plant, and last year the nominal capital was raised from £100,000 to £200,000 by the issue of 100,000 new shares at £3 each, wherewith to provide the necessary funds for the extensions and improvements. According to the plans of the rearranged plant, no amalgamation will be done in the battery, but it will all be done as the pulp leaves the tube-mills. Since the inception of the company, receipts from the sale of gold have amounted to £3,226,676, and £875,308 has been paid as dividends.

Frontenac Consolidated.—This company has been formed for the purpose of amalgamating the properties of the Frontenac Mining Co. and the Aduddell Mines Co. and extending the operations. The properties consist of mines on the same vein, three miles south of Central City, Gilpin County, Colorado. Henry P. Lowe is the manager. The ore consists of auriferous sulphides, some of the gold being caught by amalgamation in the battery, and the remainder recovered by concentration. The vein has been intersected at a vertical depth of 1800 ft. by the Newhouse tunnel. The Frontenac company has been working since 1906, and has sunk a shaft 720 ft deep and driven eight levels totalling 5500 ft. A stamp-mill and concentrating plant with a capacity of 60 tons per day has been erected, and the producing stage was reached in the middle of 1909. The Aduddell Co. is not so far forward as regards production, but 6000 ft. of development work has been done. The actual ore exposed amounts to 30,718 tons with an assay value of $9·73, and the profit is estimated at $100,939. It is estimated that the output above the level of the Newhouse tunnel will be 344,216 tons giving a profit of $1,256,484. By means of the present flotation, additional capital will be obtained whereby the treatment plant will be extended to 300 tons per day. The capital of the company is £300,000, of which 70,000 shares of £1 each are now being issued for the purpose of raising the necessary funds. The properties have been examined by S. W. Tyler, of Denver, by Forbes Rickard, and by a representative of Alexander Hill & Stewart, and the statements in the prospectus are based upon their reports.

Ferreira.—This is one of the oldest mines on the Rand, having started operations in 1887. It is on the outcrop between Robinson and Village Main Reef. In the earlier days the output used to average 1¼ oz. or £5 per ton, and the cost of mining and milling varied from 35s. to 55s. per ton. Before the war the average profit per ton milled was over 50s. per ton. Since then the equipment has been increased; the yield per ton has gradually decreased from 12½ dwt. in 1902 to 9·6 dwt. in 1909; and the cost per ton has decreased from 33s. in 1902 to 15s. 6d. in 1909. The life of the mine is drawing to a close and will probably come to an end early in 1913. The present equipment consists of 120 stamps and 3 tube-mills, of which latter one was put into commission during June of last year. The report for 1909 has just been issued. It shows that during the year 339,150 tons of ore was treated in the mill, with an average content of 10 dwt. The yield by amalgamation was 113,740 oz. being an extraction of 6·7 dwt. leaving 3·3 dwt. in the tailing. This was treated in the cyanide plant and yielded 45,376 oz. In addition accumulated sand and slime produced 3810 oz. and brought the total production to 162,926 oz., the value of which was £685,843 or 40s. 5d. per ton. The mining and development cost was £147,694 or 8s. 8d. per ton and the cost of metallurgical treatment was £88,449 or 5s. 3d. per ton. In addition administration cost £26,493 or 1s. 7d. per ton bringing the total cost to £262,636 or 15s. 7d. per ton. The profit was £423,207, and the balance brought forward from the previous year was £357,203. For the year 1909 a dividend of £570,000 has been declared being at the rate of 600% on the nominal capital. As regards the future, the ore reserve on December 31 last was 937,619 tons with an average assay value of 8·65 dwt.

Oil Companies.—The boom in oil has been strong during the last month and numerous companies have been brought to the notice of the speculative public. We have not space to devote to details. The properties acquired are situated in all parts of the world, New Zealand, Ecuador, Spain, Roumania, Sinai, Canada, &c.

Maikop Oil & Petroleum Producers.—This company has also been formed by L. W. Bates; the directorate includes H. C. Hoover and F. W. Baker. The property acquired contains the well that spouted last autumn.

PRÉCIS OF TECHNOLOGY

Electrolytic Refining of Copper.—In a paper read before the Australasian Institute of Mining Engineers in February, G. H. Blakemore gave a detailed description of the electrolytic plant for refining copper which has been in operation for 10 years at Lithgow, New South Wales, treating the black copper produced at Great Cobar. Mr Blakemore was associated with this plant for some years and he is therefore in an excellent position to give the details and hints necessary to a satisfactory working of the process. His paper is full of practical information, such as is none too common, especially on this process. The works at Lithgow are not new, and if they were re-built some improvements would be introduced, as regards labour-saving devices and a modification of the electric generators; so that this is not exactly the 'final word,' but the discussion of the technology of the process contained in the paper is not any less valuable on that account. The author first describes the plant and gives complete working drawings. Then follow a discussion of three or four points on which the success of the process hinges, and a description of the course of the process, and the methods adopted for keeping the electrolyte in good order. Finally, the result is analysed closely. The blister copper after refining in a reverberatory contains 99·4% copper and from 2 to 4 oz. gold and 15 to 20 oz. silver.

The plant consists of six sets of vats, three sets containing 96 vats each and three containing 128 vats each. Each set is supplied with current from a separate dynamo capable of producing 1200 amperes at 60 volts. This current is greater than is actually required, and could supply the requirements of 144 vats. The reason is explained later. There is also a dynamo generating 600 amperes at 25 volts used for removing excess copper from the electrolyte. The vats measure 4 ft. 3in. long by 2 ft. 6 in. wide by 2 ft. 9 in. deep internally. Each vat carries 9 anodes, and 9 cathode bars with two cathodes on each. The weight of each anode is 200 lb. The fall of level between the tanks is 3 in. The electrolyte flows from one tank to another until the eighth in each row and then into the sump-launder which returns it to the collecting-tanks. From these it is elevated by compressed air to sand-filters, which remove the gold and silver slime, and thence it goes to the feed-tanks. The flow of electrolyte is about 1½ gal. per minute.

One of the most important points connected with the process is the efficiency of the insulation, and the construction of the vats is designed with this end in view. The vats are made of Oregon pine the separate boards of which have been dipped for 10 minutes in boiling paraffin-wax. They are lined with sheet-lead weighing 6 lb. per sq. ft., the lead being brought over the top to prevent contact between the electrolyte and the wood. The pipes between the tanks are made partly of lead and partly of glass, the latter serving to insulate one tank from another. The conductors rest in glazed porcelain holders held in brackets on the outside walls of the tanks. The tanks have also to be insulated from the earth, and for this purpose are placed on hardwood seatings treated with paraffin-wax, and these seatings rest on glass insulators, which in turn rest on a framework of pine that has been treated with paraffin-wax. In addition to efficient insulation, absolute cleanliness and brightness is a prime necessity. The electrolyte used at Lithgow contains on an average 12% of free H_2SO_4 and 14% of copper sulphate ($CuSO_4 + 5H_2O$). The temperature of the electrolyte is an important point, and in this connection the experience at Lithgow is different from the statements made in Gore's text-book. With a hot solution the resistance is less and the temperature may be raised as high as the construction of the tanks will permit. At Lithgow the temperature is from 120° to 130° F. and the solution is heated by steam passing through lead coils in the distributing-tanks. The high temperature also prevents the formation of a hair-like growth of copper on the cathodes; this growth occurs in a cold solution if the free acid is strong and sets up short-circuiting, and in order to prevent its formation a cold solution must not contain more than 8% free acid, and this reduction of acidity increases the resistance. It is thus seen that with a hot solution the resistance is reduced in two ways. The objection to a hot and strong electrolyte is that it re-dissolves some copper, but this disadvantage is small compared to the advantage of decreasing the resistance, and the experience at Lithgow shows that while at first, with low acid in a cold solution the output was 80 tons per week, with a hot and strong solution the output was raised to 150 tons per week. Thus the current available could treat many more tanks now than when they were erected. Experience shows that 14 or 15% is the maximum limit for free acid, and 135° F. is the limit for temperature at Lithgow, but this might be exceeded in a new plant where the construction of the tanks and of the buildings could be altered to suit the circumstances. Other advantages of the hot electrolyte are that the gold and silver slime contains much less copper, and that the copper is not deposited as oxide, as when a weak acid is used. It is necessary to fit an air-lift agitator to each tank in order that the solution may not become stronger in sulphate at the bottom. Unless this agitating is done copper sulphate will crystallize in the bottom part of the tanks and the anodes will be more rapidly attacked from the middle upwards owing to the stronger acid content. The air-agitation also serves to oxidize some of the impurities.

The author proceeds to describe the process in action. A point in which the practice differs from that in America is that the cathodes are not all removed at once but a definite number every day; in this way the cathodes grow and the anodes dissolve more evenly. The cathodes take 14 days to grow and the anodes 21 days to dissolve. When collecting the slime, the top layer of clear liquid is removed by siphoning and the slime is baled out and placed in a lead-lined box running on wheels. When poured out of the box in the refining-room it is first passed through a sieve to remove the coarse particles of copper. The mud is then washed to free it from sulphate and it is then dried and heated in order to remove the tallow and graphite that are present owing to their having been used in making the starting skin for the cathodes. This heating greatly facilitates the subsequent removal of the copper, which is done by boiling the mud with concentrated sulphuric acid. The author describes the method of recovering the bullion and of parting the gold and silver; also the process for growing the thin copper skins that form the base of the cathodes. As the copper dissolves from the anodes quicker than it is deposited on the cathodes it is necessary to adopt means for removing the surplus sulphate. In most works the excess sulphate is marketed as bluestone, but as there is little demand for this in Australia a different arrangement is necessary. Also the sulphate produced in the refining of the mud has to be treated for the recovery of the copper. The electrolyte and the sulphate from the refinery are passed through a series of twelve tanks with insoluble anodes made of lead sheets ¼ in. thick. More power is required for current with insoluble anodes and this plant requires a dynamo with a capacity of 600 amperes at 25 volts.

From 60 to 80 tons of copper is produced per annum in this plant, an amount equal to a rise of $1\frac{1}{2}\%$ in the copper contents of the electrolyte.

The cost of erecting each tank was £10. 3s. 3d. for constructional work, and £6. 5s. 7d. for copper conductors, a total of £16. 8s. 10d. The cost of electrolysis is given at £2. 4s. 9d. per ton of copper and an additional 14s. per ton for refining the cathodes in the furnace. The analysis of the copper produced shows 99·66% metal, the balance being suboxide 0·33%, and minute fractions of gold, silver, antimony, arsenic, bismuth, nickel, lead, zinc, and selenium.

Ore-Deposits of Cobalt.— At the meeting of the Geological Society of Washington in February, S. F. Emmons read a paper on the geology of the Cobalt district, Ontario, Canada. There are three features connected with these ore-deposits that differentiate them from those in most mining districts. In the first place, from a mineralogical point of view, there is the predominance of the metals cobalt, nickel, silver, and bismuth, with an almost total absence of lead and zinc, and their prevalent combination with arsenic and antimony rather than with sulphur. Second: Structurally, the extreme narrowness of all the rock-fractures, and the general absence of evidence of any considerable displacement such as is afforded by slickensides or clay-selvages. Nevertheless, decided proof exists that the veins are true fault-fractures, not contraction-cracks, in that they contain dragged-in fragments of wall-rock, that they pass uninterruptedly from one rock formation to another, even though separated by a great unconformity, and that in the coarse so-called conglomerate, in which they were first discovered they cut through matrix and included fragments indifferently. They seem to be fractures that have been produced under so great a load of overlying rocks that movement has been restricted. Third: Genetically, the predominance of silver in the metallic state over its combinations with sulphur, arsenic, and antimony; and the remarkably abrupt falling-off in the tenor of this metal from the bonanza zone, where it is measured by thousands of ounces per ton, to the ordinary low-grade cobalt vein with less than ten ounces, a change that takes place within very few feet. These facts seem best explained by the assumption that the present veins are only the roots of veins that were originally of great vertical extent but have been mostly worn away; and that these remaining vein-roots have been gradually enriched by successive leachings back for unusually long geological periods, for both primary and secondary vein-fractures are of pre-Cambrian age. The secondary features within the veins that carry the most of the silver are probably not the channels through which the silver was originally introduced, but are those which, by the admission of solutions leached down from the surface, have produced an extraordinary enrichment in this metal. The conclusion seems warranted, therefore, that the rich silver veins are not, as was originally assumed, confined to any particular formation, and that while the bonanza portion of individual veins has a limited extent in depth, the abundance of small fractures or calcite veins that may at any time pass into bonanza, renders the future of the district promising.

Cost of Diamond-Drilling.—In the February issue of the *Monthly Journal* of the Chamber of Mines of Western Australia, J. Allan Thomson discusses the wear of diamonds in drilling. After investigation of drilling operations in the different rocks of West Australia he has ascertained the cost of diamonds per foot with a $1\frac{1}{16}$ in. core to be as follows: Kookynie and Leonora granite, 6s.; medium-grained amphibolite, Bellevue mine, Mount Sir Samuel district, 15s.; fine-grained amphibolite, Cumberland mine, Norseman district, 7s.; dense amphibolite, Gwalia Consolidated, 18s.; quartz-dolerite greenstone (micaceous), Great Fingall, 10 to 12s.; quartz-dolerite greenstone (carbonated and chloritic), Kalgoorlie, 5s.; quartz-dolerite greenstone (carbonated and sericitic), Kalgoorlie, 3s. The cleavage, as well as hardness, of the individual mineral affects the rate of drilling and of wear of the diamond; the structure of the rock also has an important bearing on the question. For instance, the granite and dolerite contain a large proportion of quartz, which is the hardest of the individual minerals, yet the amphibolite, which contains but little quartz, causes much more wear of the diamond. The comparative ease of drilling in the case of granite is explained by the coarse texture and uniformity of structure. The bounding surfaces of any two constituent minerals are plane or only slightly curved and there is little interlocking. The softer and more cleavable minerals, such as mica and felspar, are ground or split by the diamond; the quartz, thus becoming isolated, is easily broken in large pieces. The powdered rock coming from the borehole is coarse and gritty. In the quartz-dolerite greenstone at Kalgoorlie secondary changes have produced much chlorite, carbonates, and sericite, all of which are soft and cleavable, so that they are ground in much the same way as the granite. On the other hand the micaceous quartz-dolerite from Great Fingall does not show the same amount of secondary change and the structure is more interlocked, consequently it requires much more grinding. In amphibolites, hornblende is a secondary mineral and has a tendency to grow in fibrous plates with interlocking boundaries, so that though it is easily cleaved only small fragments can be detached at a time. The finer the grain and the more the amount of interlocking, the more grinding will be required and the less the rock will break.

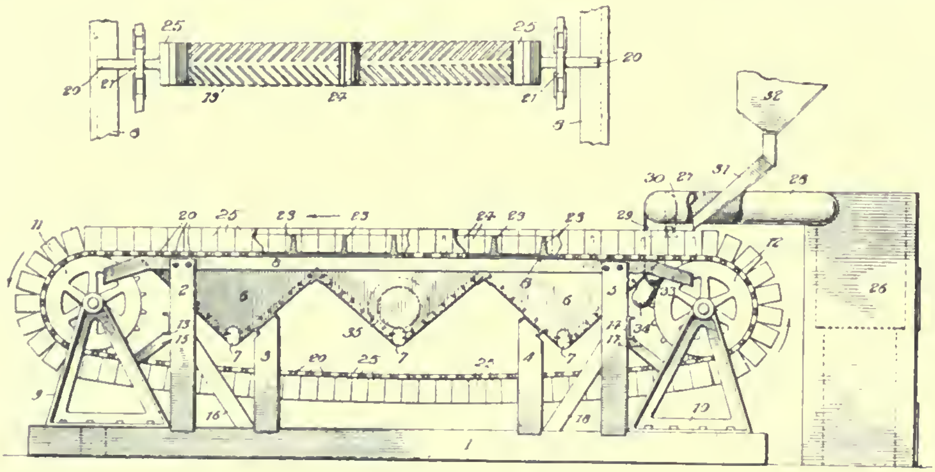
The fine-grained amphibolite in the Cumberland mine is not hard and the wear of the diamond is not great, but the rock tends to make smooth facets on the diamond, thus necessitating frequent re-setting, with the consequence that progress is slow and the labour-cost higher. The amphibolite at Gwalia Consolidated is an abnormal rock and its texture is so dense that the separate minerals can only with difficulty be distinguished under a powerful microscope. There are other rocks in the Kalgoorlie district that are easy to drill; for instance, the schists, which consist of soft minerals such as calcite and sericite. The cost per foot for these rocks is only 3s. In these figures for the cost of diamonds, the wear of only well-tested stones is included.

Young's Sintering Machine.—In the March issue of the *Western Chemist and Metallurgist*, A. B. Young, of Salt Lake City, read a paper describing his continuous sintering machine for treating fine copper ore and concentrate. Mr. Young argues that in the usual sintering pots there are losses of heat and power. In the first place it is a theoretical waste of capacity for the sintered layers to be dormant in the bottom of a pot waiting to be treated; secondly, it is a waste of power to drive air at a necessarily higher pressure through the layers below in order to reach those above; and, thirdly, the handling of the large lumps of sinter is a clumsy and expensive operation.

The author's solution of the problem lies in the development of a continuous sintering machine, taking and discharging the sintered material in thin layers. As regards the latter part of the problem, A. S. Dwight and R. L. Lloyd adopted the down-draft system, in which the air is sucked or blown toward the grate, thus hindering movement among the particles, and preventing the layers away from the ignition surface from remaining unsintered. This, of course, has its disadvantage as the corrosive, moist, sulphurous gases have to pass through the pipe-connection and the suction-fan. To the solution of the former part of the problem the author has applied the endless belt system. By erecting partitions on the bars of the travelling grate he devides it into compartments, thus ejecting the sinter in blocks of suitable size requiring no further breaking or crushing. This sintering machine consists of a grate in the form of an endless travelling belt, which carries a bed of fine and passes for nearly its entire length over a suction or wind-box, by which air is drawn through the mass. Means are provided at one end for distributing the layer of fine material over the surface of the grate and for its ignition, and at the other end the sintered product is discharged into a convenient receptacle.

Referring to the illustration, the grate consists of cast-iron segments (19) carried upon the links of the chains (21) which move upon two pairs of sprocket-wheels (11) and (12). The segments of the grate are as the top of tbe layer of ore, which is thus sintered in blocks and requires no subsequent breaking. Any form of perforation may be used for the grate-holes. In the illustration a fish-bone arrangement is shown, the elongated holes extending across the halves of two segments, thereby breaking in the middle when going around the sprocket and tending to dislodge any accretion that may have formed. The speed of the machine is from 6 in. to 1 ft. per minute; the draught is a vacuum of about 5 in. or more. The length of a machine, of 30 to 40 tons daily capacity, is 18 ft. and the width of the grate 3 feet.

Sorting on the Rand.—At the February meeting of the South African Association of Engineers, C. O. Schmitt read a paper advocating closer sorting of ore on arrival at the surface. The first part of the paper surveyed the literature of the sorting problem, and discussed the relative advantages of sorting before hoisting as against sorting at the surface. His view is that underground sorting requires a greater capital outlay and involves a higher operating cost. To do the work efficiently underground would require a sorting-station at each level, necessitating expensive excavation and plant. The operating cost would be rendered high for several reasons; working in bad air and poor light would make the labour inefficient; the cost of supervision would be greater with a number of sorting-stations; the cost of driving the plant and of maintaining it in order would also be greater. The points in favour of the underground sorting are that less ore would have to be hoisted, and that the waste would be ready at hand for packing exhausted stopes. These favourable points do not in the author's opinion outweigh the disadvantages.



YOUNG'S SINTERING MACHINE.

provided with projecting arms (20) which rest upon rails (8), in order to prevent sagging. Directly beneath the grate is the wind or suction-box (6), to which a suction-pipe is attached leading to the fan that furnishes the draught. The sprockets are mounted upon bearings and the rails and the suction-box, etc., upon supports, all of which rest upon the bed-frame (1). On the right of the illustration are shown the ignition apparatus and the distributor. The former consists of a small furnace or stove of the reverberatory type, from which the flames are led by a pair of flues around the distributor and into the igniter, which is a long sheet-metal box extending the width of the grate and 3 to 6 in. wide. This box is open at the bottom so that the flame passes from it directly through the ore. Upon this igniter is mounted the plough (40). Fine ore from the distributor falling upon the grate is spread evenly as it travels under the plough. Thus the igniter fits closely to the surface of the ore. Under the igniter, and beneath the grate, is a suction-box (33). This is connected to a pipe (34), thereby giving at the point of ignition a much stronger draught than that of the large suction-box (6). The grate is divided into compartments by the central ribs (24) and medial ribs (23) upon each third or fourth segment. These ribs are as high

Mr. Schmitt proceeds to outline the present methods in use at various mines and draws attention to some defects in economy. But the main point of his paper is the recommendation that sorting should be made a more special study, and that instead of 5 to 15% of the ore being removed, the figure should be nearer 35%. With a more elaborate plant the difference between ore and waste could be more accurately judged. The amount removed would naturally depend upon the relative width of the lode and the stoping area, but in any case 35% could be removed. According to Mr. Schmitt's system the ore would be picked out by hand as well as the waste. The benefit of the improved method could not be obtained unless the labour was of a higher class than those at present employed, namely, cripples, derelicts, and piccaninnies, and the supervision should be in the hands of men who would appreciate a bonus based upon the difference between the contents of the ore and of the waste.

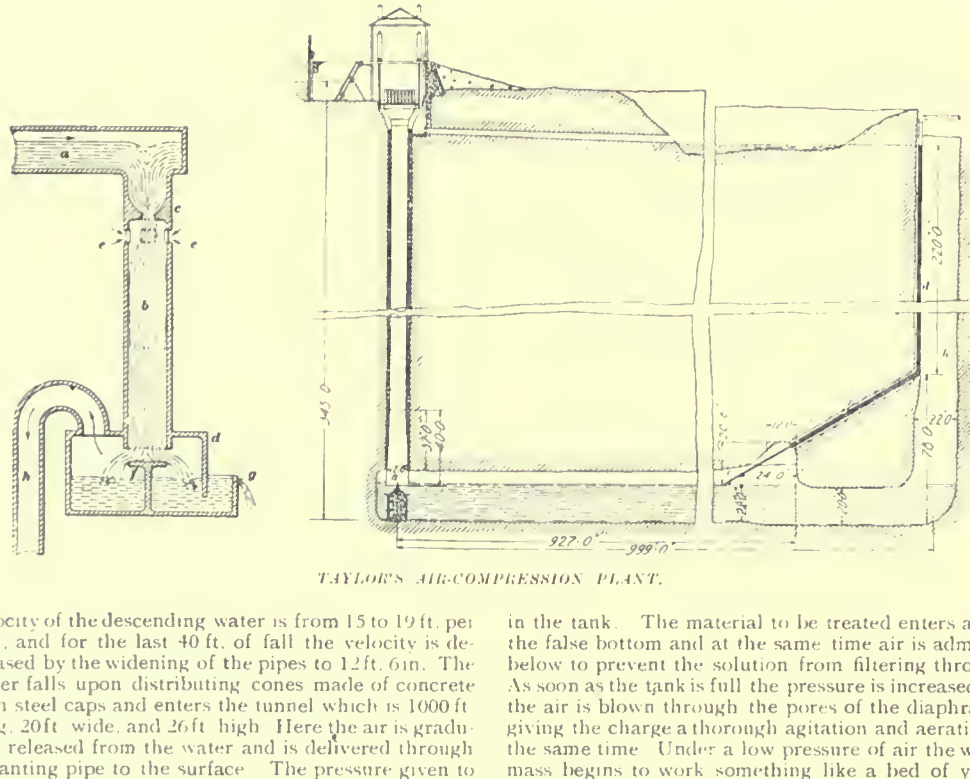
In the plant suggested by Mr. Schmitt, the ore will be delivered direct into a bin from which it will pass to washing-trommels having holes not larger than 1½ in. The finer parts will fall through, and the bulk of the ore will be fed to two parallel sorting-belts moving at a speed not exceeding 20 ft. per minute. The sorters will stand, as usual, on both sides of the belts. Those on the inside will pick out both waste rock and clean ore, the former being dropped through the floor to conveyors, and the latter placed on another travelling-belt arranged parallel to and between the two sorting-belts. The sorters on the outside of the belts will pick out waste and also such rock as has pieces of ore attached to it, that is middling, the former to be dropped upon the waste-conveyors and the latter placed upon other belts parallel to and outside the picking-belts. The clean ore goes to the fine breakers and the waste to the dumps, while the middling goes to coarse breakers, then through second washing-trommels to second picking-belts, where further amounts of waste can be removed. The central idea of this system is that by removing ore as well as waste the material on the belts is more rapidly separated, and thus there is greater chance of detecting the nature of that which is left. The sorting-belts will have to move slowly and they will have to be longer than usual so that the pickers shall have ample time to examine the material.

The first cost of this plant and also the operating cost will be higher than that of the plant at present in use, but the advantages will outweigh the difference. It is figured that the sorting can be done so closely that the waste should contain only $\frac{1}{10}$ dwt. per ton. Mr. Schmitt takes the case of a mine yielding 4000 tons per day and shows the difference in costs when 15% is sorted out as at present and when 35% is removed by his method. In the former case 600 tons and in the latter 1400 tons would be sorted out, and the amounts sent to the stamps would be 3400 and 2600 tons. The cost of Mr. Schmitt's sorting plant would be higher, say £48,000 as compared with £36,000; but on the other hand the capital outlay on extraction plant would be only £260,000 as compared to £340,000. The chief saving obtainable by Mr. Schmitt's method is in the expenditure on plant. An analysis of his figures shows that his method makes little difference in working cost and profit. For instance, if the ore raised is worth 20s. per ton then with 15% sorting, removing waste averaging 0·6 dwt., the value of the 3400 tons will be 23s. per ton, and with 35% sorting, removing waste averaging $\frac{1}{10}$ dwt., the value of the 2600 tons will be 30s. 6d. Taking an extraction of 92%, the gold won would be 21s. 3d. and 28s. per ton respectively. The cost of mining, hoisting, sorting, and milling would be 12s. 9d. per ton and 16s. 11d. per ton, and the profit per ton 8s. 6d. and 11s. 2d. per ton, respectively. Multiplying these profits by the tonnage, the figures are £43,334 and £43,550, which shows a balance in favour of Mr. Schmitt of £216. The result therefore is that practically the same profit is obtained with a smaller outlay on plant. Mr. Schmitt also points out that with the smaller plant a less expenditure on improvements would be necessary in order to increase the extraction from 92% to 95%. A question, which can only be determined in practice, is whether it will be possible to attain the requisite efficiency in sorting the ore in order to remove so large a proportion of waste having so small a content of gold.

Losses of Gold.—In the January issue of the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa, A. J. Clark and W. J. Sharwood presented a paper describing the effect of carbonaceous matter in precipitating gold from cyanide solutions. The substances mentioned include graphite, coal, coke, wood-ashes, fresh and decayed wood, etc., all of which at one time or another may by accident be present in the solution. In a series of laboratory experiments, the authors found that coke, charcoal, and coal would in a short time precipitate 20% of the gold content of the solution. With large amounts of bituminous coal or with prolonged contact, nearly all the gold would eventually be precipitated. On the other hand pure graphite such as is used in lubricants was found to have no precipitative effect. This result is at variance with the experience of precipitation by the graphite that occurs in schistose ore, as at Dharwar and Kalgoorlie, and must be explained by the different physical and chemical constitution of the raw and prepared graphite. The authors proceed to give their experience of the effect of the presence of wood ashes in the solution and show that with even small amounts of ash the extraction is seriously decreased. At the Homestake plant the extraction twice fell to below 60%; on one occasion it was found to be due to the presence in the ore of ashes from charred mine-timbers, and on the other to ashes that had been dumped into a stope at one time abandoned but subsequently re-opened. In Australia losses during cyanidation were reported at one of the mines where refractory ore was roasted in a furnace with alternate layers of wood-fuel. In California similar treatment used to be adopted in order to prepare sulphides and tellurides for the arastra; the presence of wood-ash did not interfere with amalgamation, but when cyanidation was adopted at these mines the extraction fell away. The authors next discuss the effect of wood, filter-cloths, and matting, and find that they precipitate little gold; these results do not agree with those of Simon, Bosqui, Mackay, and others who have reported in the Press at various times their experience in this connection. From this it would appear that further investigation and discussion of this point is desirable. The authors also experimented with decayed wood and found that though it contained gold, its presence was not due to precipitation but to absorption of the solution. The authors add to their paper a bibliography of articles in which the question of precipitation due to extraneous matter is discussed.

Hydraulic Power at Cobalt. In *Mines and Minerals* for April, C. H. Taylor describes the installation of hydraulic air-compressing plant on his system at Ragged Chutes, nine miles from Cobalt, whereby compressed-air power will be supplied to the mines in that district. The principle upon which this method of compressing air depends is well-known but may be restated. If water is delivered down a flume (*a*) (Fig. 1) through a contracted neck (c), on falling through into the wider portion (*b*) the water will draw air through the side holes (*e*). By the time the mixed air and water have arrived at the bottom (*b*) the air will have been compressed by the weight of the water. On delivery into the chamber (*d*) the air is liberated and escapes through the pipe (*h*) while the water finds an outlet at (*g*). The amount of compression of the escaping air will depend upon the height to which the discharge is carried. This principle was applied some years ago by Mr. Taylor, and his original patent in the United States was issued in 1895. Plants have been erected in British Columbia and California, and in 1906 an important installation was erected at the Victoria copper mine, Michigan. A description of this plant was published in the *Mining and Scientific Press* for August 18, 1906. The installation at Cobalt has once more attracted attention to this method of compressing air.

At Ragged Chutes there is a fall of 54 ft. spread over a length of 1000 ft. of the river. The amount of power produced is equivalent to 5500 h.p.; 40,000 cu. ft. of free air will be compressed per minute to a pressure of 120 lb. per sq. in. The water passes through gates, shown in Fig. 2, past screens for removing floating material, and falls down two steel pipes 8 ft. 6 in. diam. The heads of these pipes are enlarged and are in telescopic form. They are suspended from above and are automatically raised and lowered so as to regulate the flow of water according to the amount of compressed air required. The water passes into the head through a number of vertical tubes 14 in. diam. and the air enters at the side of the head through rows of smaller tubes connected with the air inlets above. The initial velocity of the descending water is from 15 to 19 ft. per sec., and for the last 40 ft. of fall the velocity is decreased by the widening of the pipes to 12 ft. 6 in. The water falls upon distributing cones made of concrete with steel caps and enters the tunnel which is 1000 ft long, 20 ft wide, and 26 ft high. Here the air is gradually released from the water and is delivered through a slanting pipe to the surface. The pressure given to the air is due to the height of the water in the outlet shaft (*b*), which is 298 ft. deep and 22 ft diam. The difference in level between the entering and the escaping water is 47 ft. This difference of level does not give the power; it only serves to make the flow through the inverted siphon sufficiently rapid for practical purposes. At the outlet for the air the tunnel is made 42 ft. high, and afterwards it is reduced to 20 ft. so that no air can pass up the outlet shaft with the water. The pipe (*d*) carrying the compressed air to the surface is 24 in diam. and at the top is connected with the 20 in. pipe that carries the air to Cobalt. By the side of the pipe (*d*) there is another pipe 12 in. diam. with its end submerged below the water. In case the air in the tunnel should attain too high a pressure the water-level will be depressed and air will escape, the pipe thus acting as a safety-valve. The two pipes are packed in concrete so that no air can escape up the rise.



TAYLOR'S AIR-COMPRESSION PLANT.

As already mentioned, the 20 in. delivery pipe is 9 miles long and the service is then divided into pipes 2 in. 6 in. and 12 in. diam. The pressure is here automatically reduced to a constant level of 100 lb. per sq. in. The air is to be sold either by meter or on a unit based on the number of drills used. If by meter, the charge will be 25c. per 1000 cu. ft. of compressed air per minute.

Spilsbury's Agitator.—At the March meeting of the New York section of the Mining and Metallurgical Society of America, E. G. Spilsbury described his method of agitating slime by means of air forced through a porous silica diaphragm arranged at the bottom of the tank. The diaphragm is a silica sponge, and is manufactured in the shape of plates about 2 in. thick and measuring 12 by 20 in. The plates form a false bottom in the tank. The material to be treated enters above the false bottom and at the same time air is admitted below to prevent the solution from filtering through. As soon as the tank is full the pressure is increased and the air is blown through the pores of the diaphragm, giving the charge a thorough agitation and aeration at the same time. Under a low pressure of air the whole mass begins to work something like a bed of yeast. The agitation is slow, no rapid movement being visible, but the whole mass is kept in constant unrest. Under the old system of treatment of gold slime the time required to obtain a 90% extraction of the metal would vary from 40 to 60 hours, while with this method a similar or even better extraction is obtained in from 6 to 10 hours, and, in many cases, where the gold is in a fine state, 99% has been extracted in two hours. The treatment of silver slime is slower, but from 90 to 95% can be extracted in from 6 to 10 hours. The more rapid extraction by the utilization of this porous medium is principally due to the difference in the manner in which the agitation is obtained. Under all former methods the agitation is always a stream agitation, in which the particles of ore are propelled in the same direction as the solution is circulated. Consequently, ore particles only change their position slowly in regard to tbe surrounding solution. With the new method, the particles of ore and the solution are changing their relative positions all the time and each grain of the ore is constantly being surrounded with a different part of the solution. There is an entire absence of any currents and the whole mass works evenly. The moment the air has passed through the diaphragm and entered the charge there is no further pressure exerted on it, its buoyancy alone bringing it gradually to the top.

A plant has been installed at Guanajuato, Mexico, and it has resulted in raising the average extraction from 87 to 97%. The cost of the material is about \$2·50 per sq. ft., including all the royalties on patents. It is practically indestructible. This material is also being applied to the filtration of flue-gases and the collection of flue-dust. By arranging the plates in parallel walls and passing the gases through them, as good results are obtained in less space than by the bag method. The cake formed on the plates is easily blown off by a simple reversal of the current.

Silver Ores of Cobalt. — The *Canadian Mining Journal* for April 1 contains an abstract of the report by A. A. Cole on the progress of mining and concentrating at Cobalt, Ontario. This report gives a large amount of information as to the production, method of selling the high-grade ore, and the steps taken to concentrate the low-grade ore. During 1909, there were 30 shipping mines, of which 17 produced most of the output. La Rose and Nipissing headed the list with over 6000 tons each. They were followed by Crown Reserve, Right of Way, O'Brien, Drummond, Kerr Lake, Trethewey, and McKinley-Darragh, with 3167, 1608, 1419, 1225, 1173, 1134, and 1056 tons respectively, The total shipment was 29,942 tons, of which 10,230 tons was treated in Canada, and 19,575 tons in the United States. The amounts sent to England and Germany were insignificant, being only 30 tons and 106 tons, respectively. Most of the ore went to the American Smelting & Refining Co.'s works at Perth Amboy and Denver, and to the works of the Canadian Copper Co. at Copper Cliff, Ontario.

The American Smelting & Refining Co. send the higher-grade ore, that is ore containing over 1000 oz. silver per ton, to Perth Amboy, and the schedule on which the purchases are made is as follows: 94% of silver paid for at New York quotation; treatment charge \$8 per short ton dry weight, plus ½% on each ounce of silver content; for each per cent of arsenic over 5% a charge of 25 cents per ton. The low-grade ore, that is anything assaying from 60 to 1000 oz. silver per ton, goes chiefly to Denver and the terms of purchase are identical for small lots, but for lots of 1000 tons or for regular supplies 95% of the silver is paid for and the treatment charge is \$7 per ton. The average cost of transport to Perth Amboy is \$9·20 per ton and to Denver \$12 per ton.

The schedule of rates paid by the Canadian Copper Co. is different, as the nickel and cobalt contents enter into the calculation. The payment for silver is on a sliding scale starting with 75% of the value when the content is 100 oz. per ton and gradually rising until 94¾% is paid for when the content is 3000 oz. per ton. No payment is made for cobalt unless the percentage is 6% nor if the nickel content is higher than the cobalt content; moreover any ore higher in nickel than cobalt may be returned at the purchaser's option. When the ore contains over 6% cobalt \$10 is paid, when over 8% \$20, and when over 12% \$30 per ton.

The concentration of Cobalt ores is a comparatively new venture. Until recently only the hand-picked high-grade ore and the high-grade screening have been shipped, and large reserves of ore carrying 30 oz. silver have been placed on the dumps or left in the mines. There are two different sorts of low-grade ore; some consists of mineral finely disseminated and the other is ore associated with rock from the walls. The former requires table concentration and the latter can be treated in jigs. At the present time there are nine concentrating plants in Cobalt and there are four more under construction. None of these are of large capacity, the nine at work being able to treat 850 tons per day. Some of these treat the ore of the individual mines, but the Cobalt Central plant receives ore from Crown Reserve and Kerr Lake as well as its own, while the mill of the Northern Customs company treats the ore from La Rose, Right of Way, Trethewey, etc. During 1909 the total ore concentrated in the nine mills was 126,421 tons and the concentrate amounted to 3241 tons, a ratio of concentration of 39 to 1. The general plan of treatment is first to crush coarsely in breakers, before jigging, then send the tailing to stamps, and treat it on slime-tables. Harz jigs and Richards pulsator-jigs are largely employed, also Hardinge grinders, Richards pulsator-classifiers, and Deister and James tables. At the Buffalo mill cyanidation is employed, and at the O'Brien a modern plant with Pachuca agitators and Moore filters has been erected to treat the slime and tailing. The flow-sheet of the O'Brien mill is given herewith.

Studies in Concentration —At the April meeting of the Institution of Mining and Metallurgy, Walter McDermott read a paper entitled 'The Elements of Slime Concentration,' in which he discussed the principles involved in the design of the various plant and machines for treating fine sand and slime. Though using the word 'slime' in his title, the author considered the treatment of all material which has passed a 40-mesh I.M.M. screen; because in his opinion it is often advisable not to treat slime by itself but to allow some fine sand to accompany it when employing certain concentrators. Mr. McDermott refrained in his paper from mentioning the specific names of machines, for the reason that it was not desirable at a meeting of professional men to induce a subsequent discussion among the various makers. We shall, however, fill in the blanks and pass from the abstract to the concrete. His hearers and our readers could not help centring their thoughts upon specific machines, and indeed it would be difficult for them to follow his segregation of the various types into groups without having the concrete cases in their minds.

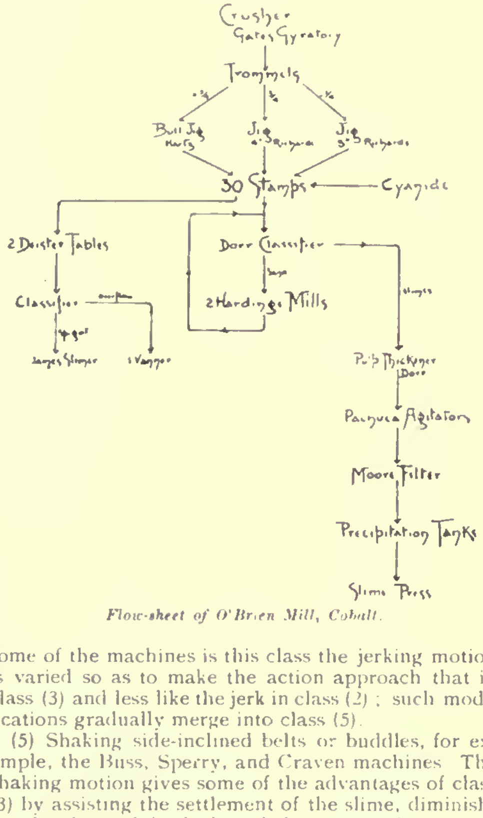
The author divides the machines into five classes, namely: (1) Fixed inclined tables, including slowly and smoothly travelling tables In this division are included the buddle (Cornish, Linkenbach, and Acme) ties, strakes, strips, frames, the Mexican planilla, the canvas table, and side-inclined non-shaking belts. All these machines depend on the greater resistance of the heavier particles to the wash of the water down an inclined surface. They do not make a complete separation into concentrate and tailing in one operation, and the middling can be re-treated on the same machine.

(2) Jerking tables, such as the Rittinger, Wilfley, Cammett, Card, Overstrom, Buss, Ferraris, Record, and Deister. These combine a greater movement across a table with a greater resistance to a wash of water down the table on the part of the heavy particles as compared with the lighter waste. These machines also make a middle product.

(3) Shaking belts, for example the Frue, Johnston, Triumph, Union, Isbell, and Embrey vanners. These machines present a greater complication of conditions than (1) and (2), and without a full consideration of

their action their applicability and efficiency are likely to be misunderstood. The vanning motion not only settles the heavy mineral upon the travelling surface but it also prevents the larger particles from clinging. The upward travel of the belt is in the opposite direction to the flow of water, tending to keep a bed of the coarser particles on the belt, so as to prevent the too rapid flow of fine material down the incline. The shaking motion keeps the bed from becoming packed and thus allows of much less inclination than on a fixed table, and therefore a slower current of water. These machines make no middle product ; this is an advantage where only one class of concentrate is desired, but prevents their use where there would be more than one product.

(4) Jerking belts, for example the Luhrig. The concentrating process is the same as in class (2), but it is done on a side-inclined belt travelling in the direction of the throw of the concentrate ; the discharge is assisted by the travel and so does not depend entirely on the throw. This class makes a middle product. In



Flow-sheet of O'Brien Mill, Cobalt.

some of the machines is this class the jerking motion is varied so as to make the action approach that in class (3) and less like the jerk in class (2) ; such modifications gradually merge into class (5).

(5) Shaking side-inclined belts or buddles, for example, the Buss, Sperry, and Craven machines. The shaking motion gives some of the advantages of class (3) by assisting the settlement of the slime, diminishing the slope of the bed, and decreasing the amount of water required, but the longer settling-surface and the thickening effect of the upward travel of the ordinary shaking belt are not obtained. Another difference is that a middle product is made.

To understand the conditions which are necessary for a close saving of fine material it is only necessary to go back to the vanning-shovel. The shovel must be well managed, smooth, and have a slight curve in every direction. Two movements are employed in using the shovel, one for throwing the fine sand upward and the other for separating the waste in the slime. The first movement is the same as that of the jerking machines in classes (2) and (4). The second consists in washing away the waste by a succession of waves of water produced by a shaking motion, after the material has been settled on the surface of the shovel, and is similar in varying degrees to the actions of classes (1), (3) and (5). Mr. McDermott proceeds to analyse the conditions necessary for the successful action of the shovel in detail, under the heads of (*a*) time given for settling, (*b*) the smoothness of the surface, (*c*) the gentleness of the flow of water, and (*d*) the motion requisite for the differential settling and separation. By deduction he points out that the conditions which should be kept in mind by the inventor of a slime concentrator likely to be a real improvement over existing ones are : a large smooth surface, a regular settling motion which does not jar the finest particles from their contact with the surface after settlement, and the delivery of a clean concentrate without any middling. The provision of a suitable settling motion insures the other necessities, namely, the slight inclination of surface and the minimum quantity of water required.

Finally, the author discusses the question of classification, and again referring to the vanning-shovel, points out that this instrument does excellent work on mixed material, so that in theory there is no definite law in favour of classification. He also gives his own personal experience of 30 years that there is a distinct advantage in using an unclassified pulp on machines of class (3). The coarser particles that form a bed on the belt act as a check to the otherwise rapid flow of the slime and thus afford it a greater chance of settling upon the surface of the belt.

The author also shows that many of the classifying machines are not efficient. For instance in the pointed box the coarse bottom discharge is always accompanied by a stream of the finest slime. An improvement on this is found in upward-flow classifiers, but these have the disadvantage of greatly diluting the pulp and involve the subsequent use of large thickening tanks. In some cases engineers have wrongly considered machines belonging to class (3) unsuitable for slime and have used them on intermediate products. This view is opposed to experience and practice, and to the objects for which the machines were invented.

One conclusion from the author's remarks on modern practice is that in some mills classification is so badly done that every sand-table receives a small stream of the finest slime, which it is not adapted to save ; and that the bulk of the slime on reaching the shaking-belt machine is too thin and too free from fine sand to be worked to best advantage. A further deduction is, that even in the best arranged mills, where hydraulic classifiers are used and slime kept off the sand-machines, the classification is carried too far ; closer work would be done on the final belt-machines if some fine sand were permitted to accompany the slime, and the tailing re-treated on a second set of belt-machines. Briefly, his general deduction is that when practice shows a poor extraction of the slime mineral when fed alone on these shaking-belt machines, it is probable that classification had been carried too far.

Analysing Rand Results.—In our April issue we gave an outline of the new method of recording the extraction of ore, proposed by Hugh F. Marriott and introduced at the mines of the Wernher-Beit group. As there has been some misunderstanding in various quarters in regard to the object and value of this innovation, Mr. Marriott took the opportunity, at a dinner given by Lionel Phillips at Johannesburg on March 23, of furnishing further information and of elucidating the advantages of his method. This speech has been printed in pamphlet form.

Mr. Marriott's scheme for keeping records of output and content is intended primarily for the manager and engineer—not for the public or the shareholder. It will help to differentiate between profitable and unprofitable material in various parts of the ore deposit, to keep close watch on the stoping widths, and to ascertain the extraction from any block as compared with its estimated content; in this way it will aid the engineer, but it will not convey much to the shareholder unless he is familiar with the working of the mine. It is, in effect, only a means to an end; for the ultimate result of operations in the mine and mill will still have to be reported in tons mined and crushed, and gold extracted. Mr. Marriott reckons the amount of ore extracted on the basis of the area exhausted on the plane of the 'reef.' From measurement of the area of ore in place and of ore removed, in conjunction with the average stoping width, the average gold content, and the cost of mining and milling, the final profit from each block of ore can be accurately stated. In this way the profitability of each block can be ascertained both by estimate and result In the mine-account ledgers separate pages are used for each block; there the yield, cost, and profit are recorded. Thus each block will stand on its own merits and if unprofitable it will not be worked; it will be impossible to add layers of unprofitable to profitable ore, a proceeding common enough and indeed often encouraged when it brings about a reduction in the average working cost.

In his speech Mr. Marriott points out that the two principles of high profit and low cost sweep over the Rand in recurring cycles, so that the mean between the two extremes is hard to preserve. In 1896 a reaction against a wave of low cost took place when R.W. Schumacher gave his support to high cost and high profit. An era of sorting and selecting then came to the front, but it was soon found that this did not give a large enough supply to the mills, which had in the meantime been increased, and since then the main tendency has been to send as much ore to the mill as possible provided that the average was profitable. Under such conditions of work it is obvious that the cost per ton had to receive special study. As Mr. Marriott points out, the 'ton milled' is an indefinite unit, for a manager may include in his ore anything between the 2 ft. pay-streak and an 8 ft. stope. A profitable width may yield 30s. gold at a cost of 20s. per ton. By doubling the width another ton worth 15s. may be extracted and treated at a cost of 15s.; so that two tons will be mined yielding 45s. at a cost of 35s. In both cases the profit will be the same, namely 10s. The shareholder will not be any the better off, but the mill will be running at full capacity on a lower average yield, and the directors will say that the life of the mine is being doubled. The latter contention, of course, is correct if the mill is to be operated at full capacity, but if it is possible to develop and mine sufficient 30s. ore to keep the full mill working, the yearly profit would be doubled though the life is halved, and the shareholders would reap the benefit due to the more immediate realization of profits. If the rate of supply of high grade ore is not kept up, and in most cases it could not be, then the mills would not work at full capacity. As Mr. Marriott says, there is a sentimental idea that the closing of part of a mill even for a time is a dire calamity; and besides, when such a thing occurs the cost goes up. Two such events would not be understood or appreciated by the public, and to talk about hanging up stamps is more than the average engineer cares to do. The benefit of Mr. Marriott's scheme will not be fully reaped in mines where there is a large plant already in existence; the full advantage will only come when a new plant or an extension of operations is contemplated. Under his system of excluding unprofitable layers and blocks of ore a smaller plant will yield an equal profit or an existing plant can be made to treat ore from an extended mine.

The one point to be settled before working with Mr. Marriott's cost-sheet is the limit of profitableness of the ore in each mine. At first this must be in the nature of an estimate, the responsibility for which remains with the consulting engineer. After a quarter or a year, more definite information will be available and the stoping width may then be altered, and areas struck out or included. The system thus divests the manager of the unpleasant responsibility for idle stamps..

It will be seen that the system requires accurate measurements and records of the ore in reserve; in fact, without the greatest accuracy the system may be easily vitiated. Another of Mr. Marriott's arguments is that every cost, of whatsoever character, must be included. Many mines omit taxes, administration, development charges, and depreciation, with the obvious object of showing a low working cost, but these items are just as essential as the expense of breaking ore. While addressing the company of engineers, Mr. Marriott took the opportunity of pressing home some other details connected with mine management that will make for efficiency, such as improved ventilation and more generous terms for contract work. As regards ventilation, he strongly advocates the provision of a larger supply of fresh air than is required by law, and in speaking of prices paid for mining work he took the same line as H. P. Gillette in the paper abstracted in our February issue.

Magnetic Separation at Monteponi. — E. Ferraris gives some information about the Monteponi mine, Sardinia, of which he is manager and engineer, in the transactions of the Associazione Mineraria Sarda. The mill gives concentrates of zinc, iron, and zinky dolomite. By means of a slight roast the iron is made magnetic. The ore is then submitted to magnetic treatment and thus freed from the iron, and after that it is treated by water concentration in order to rid the zinc of the dolomite. The calciners are 13 m. long and have an inner diameter of 1·30 m. and an incline of 6%. They are provided with a 6 in. lining of firebrick and are driven at 16 revolutions per hour. In 1908 three calciners gave the following results: Hours at work, 15,800; tons of ore milled, 15,137; tons of ore roasted, 12,184; fuel consumed (lignite), 2296. The lignite gave 23% ash. The gas at its exit from the calciners has a temperature of 300 to 350°C. and is passed to the boiler furnaces. The roast is done at a cost of 4·76 fr. a ton. The magnetic plant is composed of six electro-magnets. Beneath these a thinly spread layer of ore is made to pass by means of a belt conveyor. It is first classified into six sizes from ½ to 10 mm. The power required for each magnet is 100 w. and the capacity of each is a ton per hour.

Copper-Nickel Metallurgy.—The similarity of behaviour of copper and nickel in the converter is the subject of a paper in the April *Bulletin* of the American Institute of Mining Engineers contributed by D.H. Browne, metallurgist to the Canadian Copper Co. The author shows that the old theory that nickel could be classed with iron in converter reactions has been exploded, and that in their resistance to oxidation nickel and copper act together. The paper has been prompted by the author's experiments in connection with Monel metal which is produced direct in the converter from the Canadian Copper Co.'s ore.

BOOKS REVIEWED

WEST AFRICAN GOLD MINING ACCOUNTS. By F. J. Lock. Cloth, 8vo. 128 pages. London: Gee & Co. Price 5s.

This little book contains a mass of information useful to the mine accountant generally and not only to those concerned in West African mines as is implied by its title. Close on seventy specimen forms are given, and these for the most part have been put to the test by actual use, and they represent in the main an admirable system of accounts suitable for either small or large undertakings. The system elaborated is particularly applicable to gold mines where natives are employed. We do not like however the form of the mine cost-sheet given, nor the classification of the expenditure in the mine profit and loss account, neither of which are in accordance with the recommendations recently issued by the Institution of Mining and Metallurgy, nor with the practice of the best English companies. A working account that only shows the total cost of mining, development, milling, cyaniding sand, treating slime, general expenses, general maintenance, and depreciation, and neglects to show the separate costs of stoping, timbering, hoisting, pumping, etc., is clearly not an ideal one, while the monthly cost-sheet recommended, although not complicated, does not take a form most useful to a busy mine manager, and omits to show many figures which a manager ought to have before him. Subject to the criticisms we commend it to any accountant or manager in search of a useful reference book. H. E. F.

THE DAVIS HANDBOOK OF THE COBALT SILVER DISTRICT. By H. P. Davis. Paper covers. 110 pages. Ill. Toronto, Canada: *The Canadian Mining Journal*.

This book is a directory of mining companies operating in the Cobalt district, but it gives much more information than the usual investor's handbook. In addition to a list of all the companies registered and general information relating to them, the book contains detailed accounts of the mining and metallurgical progress at the actively producing mines. An outline is given of the geology, methods of mining, sale of ore, and concentration. There is also a map showing the position of the various mines and claims. For the non-technical investor the book gives an intelligent account of the finance and technology of the district, and it does not appear to be aiming at any ulterior object.

METALLOGRAPHY. By Cecil H. Desch. Cloth, 8vo. 440 pages. Ill. London: Longmans, Green & Co. Price 9s. For sale by *The Mining Magazine*.

Metallography is a science devoted to the study of the structure of metals and alloys and the relation of their structure to their composition and to their physical and mechanical properties. Originally the word was used in connection with microscopic examination but it is now employed in a broader sense. Though the structure of metals had been studied for centuries, it was not until 1864, when Sorby, the founder of microscopical petrography, applied his methods of research to iron and steel, that metallography became a recognized science. Subsequently Martens, Osmond, Wedding, and others established the study on a firm footing. It has to be confessed that Continental and American workers are ahead of the English in their studies of metallography and most of the literature on the subject emanates from those sources. It is pleasant therefore to receive this book from an English author, who is now lecturer on metallurgical chemistry in the University of Glasgow. He conducted much of his investigation work with A. K. Huntington, the professor of metallurgy in King's College, London. This book is perhaps the best book for the comparative beginner, for the wording and descriptions are such as make the arguments easily followed; and yet it is far from being an elementary book.

The author considers thermal analysis the foundation of metallographic investigation and the first portion of his book is therefore devoted to the diagrammatic treatment of thermal equilibrium. He discusses the principles of cooling, describing eutectic solutions, freezing action, solid solutions or mixed crystals, and proceeds afterwards to discuss ternary alloys and partly miscible liquids. Subsequently he deals with pyrometry, the preparation and examination of micro-sections, the crystallization of metals, under-cooling and the meta-stable state, and diffusion in the solid state. Then follow chapters on the physical properties of alloys, corrosion due to electric action, plastic deformation, the nature of polish, and the characteristics of certain standard industrial alloys.

AN INTRODUCTION TO PETROLOGY.—By F. P. Mennell. Cloth, 8vo. 210 pages. Ill. London: Gerrards, Limited. Price 8s. For sale by *The Mining Magazine*.

This is the second edition, but as the book is little known in England a notice is deserved at the present time. The author has lived for some years in South Africa; his book is based upon his own experience and investigations, and the accompanying illustrations, of which there are many, have nearly all been drawn or photographed by him from his own specimens. There is therefore an individuality about the book. As the author is specially familiar with Rhodesia his examples of minerals, rocks, and rock formations are additionally interesting in that they give information about that country. The photographs of a granite kopje in the Matoppo hills and of the columnar structure of the basalt flows in the gorge of the Zambesi river make us wish for more of the same sort. Generally speaking, the book is intended as a guide for the geologist who desires to learn from experience in the field rather than as a textbook for a college course. The author is thoroughly familiar with the various systems of classification, with the theories of origin of the rocks, and of phenomena connected with them, and discusses them freely in the light of his own experience. His views will be of interest to the propounders of propositions from which he dissents, as well as to the reader who desires to get a general idea of the questions.

TIN-FIELD OF NORTH DUNDAS.—By L. Keith Ward. Pamphlet. 160 pages, with maps and illustrations. Hobart, Tasmania: The Department of Mines.

This is one of the publications of the Tasmanian Geological Survey and gives in great detail a description of the tin deposits of North Dundas as far as is possible with the present restricted workings. The district is northeast of Zeehan and south of Mt. Bischoff, and both gravel and lodes have been worked. The lodes and the gossans are of unusual mineral composition; both the lodes and the rock formations are complex and the miners have found them difficult to follow. The deposits have been known for many years and have before now been the subject of official reports. The presence of pyrite has been supposed by many to be inimical to the successful metallurgical treatment of the ore, but Mr. Ward sees no reason for this view. The future of the district depends on whether the operators can combine and raise liberal funds for further development work.

CURRENT LITERATURE

Analysis at Cananea.—In *The Mining World* (Chicago) for April 2, Evans W. Buskett gives an account of the methods of analysis employed at the Cananea smelter, Mexico, in connection with ore, slag, bullion, and chrome bricks.

Cerro de Pasco.—In *The Mining World* (Chicago) for April 2, a translation is published of the article by Lester W. Strauss that appeared in the Boletin De la Direccion de Fomento, Lima, describing the smelting works of the Cerro de Pasco company.

Necaxa.—In the *Mexican Mining Journal* for April, H. E. West gives an account of the Necaxa hydro-electric plant, which is well known as a supplier of electric power and light in Mexico and El Oro districts.

High-Pressure Gas.—At a meeting of the Society of Chemical Industry held in London in March, A. W. Onslow gave particulars of the application of high-pressure gas for heating purposes, especially in connection with its application for melting and heat-treatment of metals. The ordinary coal-gas is compressed by a small engine, and in Birmingham arrangements are being made for distributing gas at high-pressure through special mains. The heat obtained by this means is much higher than by burning gas at ordinary pressure, and the advantage of gas in metal working operations is that the heat is more easily controlled and that it is cleaner than coke or coal.

Concentrating Lead-Zinc Ore.—In *Mines and Minerals* for April, L. A. Palmer describes the 400-ton concentrator at Midvale, Bingham Junction, Utah, belonging to the United States Smelting Co. The ore averages 9% lead, 8 to 9% zinc, 13 to 14% iron, with some copper, gold, and silver. Two products are formed, one containing the lead, gold, silver, and copper, and the other the zinc and iron which are subsequently separated electrostatically by the Huff process, which we described in our issue of December. The present article is concerned only with the wet portion of the plant.

Steptoe Smelter.—In *The Mining World* (Chicago) for April 2, L. A. Palmer describes the Steptoe smelting plant, Nevada.

Granby Smelter. — In *Mines and Minerals* for April, B. L. Sackett gives an account of the Granby smelter, British Columbia. The plant is notable as it treats 4000 to 5000 tons of ore per day, containing only 1½% copper and small quantities of gold and silver. It has been in successful operation for 10 years. Attention has recently been attracted to this mine on account of the sudden discovery that the ore reserve is much smaller than was supposed.

Washoe Smelter. — In *Mines and Minerals* for April, an article is published describing recent detailed improvements in the Washoe smelter at Anaconda, Montana. The information relating to the machine for lining the converters and to the methods of repairing the converters is of special interest.

Midvale Lead Smelter.—In *Mines and Minerals* for April, L. A. Palmer describes the lead smelting plant at Midvale belonging to the United States Smelting Co.

Congo Territory.—The April *Bulletin* of the American Institute of Mining Engineers contains a paper by S. H. Ball and M. K. Shaler entitled 'Mining Conditions in Belgian Congo.' The authors spent two years in the territory on behalf of the Societe Internationale Forestiere et Miniere du Congo. The paper describes the geography, geology, and general mining conditions and prospects, and is an interesting contribution to mining literature.

Plotting Co-ordinate Surveys.—In the *Mining and Scientific Press* for April 2 and 9, J. J. Bristol describes a device for plotting co-ordinates and gives many of its applications in mine surveying.

Errors in Analysis.—R. C. Benner, in the *Mining and Scientfic Press* for April 2, discusses errors in analysis due to incorrect weights and measures, and gives methods of testing the accuracy of weights, pipettes, burettes, etc.

Mining Methods on the Rand.—In the February issue of the *Journal* of the Chemical, Metallurgical, and Mining Society of South Africa, Tom Johnson presented a supplementary paper in which he gives numerous suggestions and criticisms in connection with mining practice on the Rand.

Zinc Ore at Oker.—In the *Engineering and Mining Journal* for April 16, Hermann Pape gives a detailed account of his process for extracting zinc oxide from slags produced by the lead and copper smelters in the Lower Harz, Germany. The ore in this district consists of a mixture of pyrite, chalcopyrite, galena, and blende, with barite. The Pape process is at work at Oker, where a plant was erected by the International Metal Company.

Fuel for Reverberatories.—In the *Engineering and Mining Journal* for April 16, C. A. Grabill discusses the calorific value of various fuels used in reverberatories, wood, coal, oil, and gas, and points to the future adoption of regenerative furnaces using producer-gas.

Rope-Knots.—In the *Engineering and Mining Journal* for April 2, 9, 16, and 23, A. Livingstone Oke gives instructions in the art of using ropes, and of making loops, knots, and junctions.

Smelting Bismuth Ore.—In the *Engineering and Mining Journal* for April 9, S. E. Bretherton describes his experience in designing a method of treating gold-bearing bismuth ore in Sinaloa, Mexico. The smelting was done in a small blast-furnace, and lead sulphide was added so as to bring the content of the charge to 10% lead and 2% bismuth. In this way 80 to 90% of the bismuth and gold was extracted.

TRADE CATALOGUES

Wm. Ainsworth & Sons, Denver, send their list of balances, and of theodolites and other surveying instruments, including the Brunton pocket transit. The apparatus are all their own manufacture and are of the highest quality. The balances are made in a great variety of types, and are designed to give the most accurate results with the least expenditure of time.

The Worthington Pump Company, London and Newark-on-Trent, sends us their catalogue of electrically-driven centrifugal pumps. These are made for three different services, low, medium, and high lifts. The last named have a special application in mining, and are used in mines in all parts of the world, from Botallack in Cornwall, to Caylloma in Peru, and Premier Diamond in the Transvaal The medium lift pumps are in demand for circulating water in the jackets and tuyeres of blast-furnaces. The company also sends catalogue of their water meters and condensers.

George Cradock & Co., Ltd., Wakefield, send us a handsome catalogue relating to their steel wire ropes which are employed in every country, the United States included, for mine haulage, cable tramways, ship hawsers, aerial ropeways, suspension bridges, etc. The catalogue gives a great deal of information about accessory plant and apparatus, and details as to the applications to which the ropes are suited. The firm has also published a new catalogue of mining tool steels, and special alloy steels.

The Mining Magazine

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Scientia non habet inimicum nisi ignorantem.

T. A. RICKARD, Editor. EDGAR RICKARD, Business Manager.

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CONTENTS.

REVIEW OF MINING

INTRODUCTORY.—The mining and financial markets throughout May can be described as quiet and dull. Two weeks of funereal honours to the late King created a profoundly depressing atmosphere and the real sorrow of the English people, still indicated by general mourning, has led to the postponement of much activity, both social and industrial. A stimulus to a more cheerful attitude was furnished by the inauguration of the Union of South Africa, by the visit of Mr. Roosevelt, by the abatement of political controversy, and most of all by the fine weather. The race for the Derby was run on a beautiful day and it is interesting to record the association of this event with mining, for the 'Mr. Fairie' whose horse, Lemberg, won the blue riband of the turf is a Mr. A. W. Cox, who acquired his wealth out of the silver-lead mines of Broken Hill.

The Board of Trade returns for May exhibit an increase of £15,000,000 in exports and imports, indicating that the trade of the United Kingdom is expanding at a rate promising to make 1910 the best on record. The Bank rate is at 3%, but money is not plentiful, although speculation has subsided. No great activity is likely now until after the summer vacation, for the Britisher's holiday, like the Mexican's *fiesta*, is taken religiously.

SOUTH AFRICA.—Our correspondent at Johannesburg sends several interesting items of news. Apparently Mr. Marriott's 'square fathom' has met with violent opposition. Some of it may be reasonable, but some of it is undoubtedly due to the fact that the expression of results in terms of tonnage has been grossly abused by two or three managers anxious to make a record for low costs. The subject will continue to excite acute controversy. We shall be glad to hear from both sides, for the matter strikes at the foundation of mining economics.

Labour returns for May show a decrease of about 1000 natives, this being the first diminution since September. A further loss is likely during the next three months, and this will depress the share market, for the public forgets that the tide of Kaffir migration to the Rand ebbs and flows with the seasons. In our summer, which is their winter, they go home to buy wives and sow corn. Since the Chinese left a cheerful increase of native labourers has been recorded, but most of these are raw recruits and lack efficiency. As soon as they become efficient they return to their kraals with their savings, so that the labour difficulty is perennial. Arrangements for recruiting are continually being improved and the union of the South African States should facilitate such work, but patience is needed, on the part of shareholders as well as managers.

RHODESIA.—The adverse report of Mr. A. H. Ackermann on the Selukwe came as an unpleasant reminder that mines are mortal. This decisive verdict came on the top of favourable rumours, and created a bad effect. On the other hand, the Globe & Phœnix developments are excellent; the sixteenth level is richer than the fifteenth and has been advanced in ore assaying 17 oz. for a width of 4 to 5 feet. But nothing is said about the results in winzes.

WEST AFRICA.—The Ashanti Goldfields reports that the roasting furnaces have been completed, and that the monthly output before long will be raised gradually from £26,000 to £40,000. We hear that the Odumassi concession, 27 miles southeast of Kumasi, is to be prospected once more, this time by the newly formed company, United Ashanti Lands, which is a consolidation of Gold Coast United and the Ashanti Lands Co. At Abbontiakoon development still continues to absorb the chief attention. On March 31, the reserve was estimated at 228,074 tons averaging 13·2 dwt. Other blocks aggregating 208,131 tons are expected to be eventually profitable, if the operating cost is reduced, and provided a suitable sorting plant can be erected that will produce a mill-ore averaging not less than 6 dwt. The early resumption of milling is not contemplated and possibly the metallurgical plant may be remodelled. Prestea Block A continues to develop satisfactorily; on March 31 the reserve was 519,030 tons averaging 10 dwt. The foundations for the 110-stamp mill have been laid and milling will be resumed in November. The railway has reached the Ancobra river and is within two miles of the mine. The necessary bridge is under construction. The Anfargah property in the Prestea range is about to be developed, and for this purpose £125,000 is being subscribed by the West African Trust.

An error in cabling, whereby an average assay of 2 dwt. was reported as 1 oz. 2 dwt., perturbed holders of Ashanti Quartzite and placed the acting manager in an embarrassing position. The incident may serve to warn mine officials to exercise care in the use of code-books.

NIGERIA has been attracting attention owing to the discoveries of oil and tin. We publish a timely letter from Mr. L. H. L. Huddart, who has recently returned from this region. Unlike the West Coast, it is healthy, as is indicated by the fact that horses and cattle thrive, so that transport is facilitated and fresh meat is assured. It is announced by Sir William Wallace, the Resident-General of Northern Nigeria, that the Imperial Government will construct a railway into Bauchi, the Province in which the tin is being exploited. The new line, a branch of the Baro-Kano railway, will be 120 miles long; pending construction, a motor-road is being built for the transport of heavy machinery. Several people of acknowledged standing are interested in Nigerian tin ventures and as they are acting under excellent professional advice we expect to see the development of a successful mining industry in this part of Africa.

AUSTRALIA.—Rain, much needed, has fallen copiously in Tasmania and Victoria. Owing to the lack of water the Mt. Bischoff mine had closed down and at the Briseis the supply for washing the tin gravel had fallen from 100 to 30 sluice-heads.

Our Melbourne correspondent writes concerning a new silver-lead deposit discovered at Mt. Maroomba in the Northern Territory. The locality is in a remote portion of Australia and is reached from the Roper river, a navigable stream, thence 80 miles in Arnheim Land. The formation is limestone, the ore itself being found near the contact with diorite. The prospector, T. J. Broadstreet, says that two outcrops are so large that neither of them could be covered by an 80-acre lease. Galena lies exposed in large quantity. A small company has been formed to send experts to investigate. The country is flat, well timbered, and offers no serious obstacles to mining operations.

News from the Great Fitzroy is disappointing. Mr. W. J. Loring is investigating the causes, which relate mainly to difficulties in smelting the concentrate. Losses in flue-dust are excessive. Hence the yield per ton has decreased while the cost remains undiminished. Owing to the delay and increased cost of plant, the board has decided to issue £75,000 in 6% first mortgage debentures.

We hear that Amalgamated Zinc (De Bavay's) Limited has acquired an option through Mr. W. L. Baillieu, the chairman, on the Potter patent rights.

The prosperity of the great mine at Mount Lyell, in Tasmania, is evident from the half-yearly report, summarized elsewhere. The low-grade ore on the bottom levels of the Mount Lyell mine itself is now being profitably exploited, by admixture with the high-grade product from the North mine, where deeper developments are excellent. The consolidation of these two mines assured the future of the Mount Lyell company. In this connection we note with interest the acquisition of the Cobar Gold Mines by the Great Cobar, in New South Wales, whereby a gold-bearing silicious ore is rendered available for mixture with a basic copper ore. The Cobar Gold Mines ore contains 10 dwt. of gold and 1% copper and is not amenable to concentration, amalgamation, or cyanide. It had been proposed to adopt a process for removing the copper by leaching with subsequent amalgamation and cyaniding, but the capital expenditure for the necessary plant was greater than the company was prepared to provide. As the Great Cobar was anxious to secure silicious ore to mix with its own, the amalgamation was obviously mutually useful.

IN MEXICO the oil production for the fiscal year 1908-1909 is given as 425,000 tons. A disastrous fire hindered production at the most productive spot, for the spouting well at Los Bocas caught on fire, like the Maikop gusher in the Caucasus, and the Beaumont well that gave fame to the Texas oil-field. The coastal plain fringing the Gulf of Mexico is traversed by an oil-bearing belt, which is the extension of that exploited in Texas. From Tamaulipas to Campeche indications of oil are readily found. At Elbano, 50 miles west of Tampico, the Mexican Petroleum Co. obtains heavy asphaltic oil from Jurassic strata penetrated by eruptive rock. The oil is used on the National Railroad. Between Tampico and Tuxpan the blue marl overlies a porous limestone saturated with oil, which has accumulated in places where the formation is traversed by dikes of eruptive rock, serving as dams. Such pools are usually marked at surface by oil springs, the emanations from which evaporate and dry, leaving a deposit of asphalt.

The attack on Valladolid and the insurrection of Indians in Yucatan does not affect mining operations, for that part of Mexico is chiefly used as a convict settlement and for the cultivation of hennequin, a variety of hemp. But it does savour of *la malice des choses* that the prospectus of the United Railroads of Yucatan should appear in the daily Press on the same day as the news of the native outbreak.

In a recent issue we contradicted the report current in Mexico City that the Exploration Company had purchased the Reforma group of mines in Guerrero. It is now officially announced that the option has been dropped. This company has options in the Santa Eulalia district of Chihuahua, but no large deals have been recommended by Mr. R. M. Raymond, as yet. At El Oro the three English-owned mines are doing well, reducing expenses without sending waste to the mill. The Mexico has cut the West sulphide or Esperanza bonanza vein on the eighth level, the ore assaying $30 in gold and 16 oz. silver for a width of 19 feet. A clever Press campaign has been made in London on behalf of the Carmen mine, the references being of an optimistic character but so vague as to compromise nobody. A good market for the shares has been created. The Esperanza company has held a satisfactory annual meeting, the output being £429,630, and the profit £161,480. The re-grinding of the ore to 200 mesh has decreased the capacity of the mill but improved the extraction. Additional tube-mills have been ordered, four being in course of erection, making a total of 14, so that the full estimated capacity of the mill will shortly be realized. Recent exploration underground has given encouraging results, the cross-cuts in the middle portion of the mine having found several ore-bearing veins.

NORTH AMERICA.—The attempted Federal regulation of freight rates has precipitated a political and financial fight between the Government of the United States and the big railroad companies. To frighten the public a heavy drop of share-quotations has been permitted, if not forced, and industrial conditions, especially the steel trade, are seriously upset.

Reference was made in our last issue to the burning of part of the mill of the Goldfield Consolidated, in Nevada. We note with interest that the contents of the Merrill precipitation-presses were saved intact, although the presses were so hot that the excess zinc was burning inside and the solution spigots were discharging a pure zinc flame. Thus 11,000 ounces of gold was saved, as compared to the inevitable loss if the metallic product had been stored in the usual zinc-boxes. In April the Goldfield Consolidated earned a profit of $839,000, the decreased tonnage treated, owing to the damage to the mill, being compensated by the selection of richer ore. This mine is now earning at the rate of $8,000,000 per annum. The rush to Portland Canal (separating British Columbia from Alaska) continues and 10,000 people are now gathered in the new town of Stewart. The mineral discoveries contain copper and gold. There is some interest in New York over the recent discoveries at Porcupine, in Ontario, and the new goldfield near Elk City, in Idaho.

In the Yukon the dredging season opened on April 27, which is unusually early. On the Seward peninsula a heavy snowfall during the past winter promises plenty of water this summer. Gold is arriving from the North ; $20,000,000 is expected shortly from the Alaskan mining districts.

Conditions affecting the copper market remain unchanged. The hope that consumption would overtake production has not yet been fulfilled, and in the meantime several large mines of the 'disseminated copper' type are approaching the productive stage. The Utah Copper company's output for the first quarter of 1910 was 18,511,819 lb., at a cost of 8·43 cents per pound of copper.

The American Copper Producers' Association states that production during May amounted to 123,242,000 lb., an increase of 5,764,000 lb. as compared to April. Deliveries for consumption and export were 104,801,000, an increase of 5,483,000, and stocks at the end of May aggregated 160,426,000, an increase of 18,442,000 lb. for the month.

INDIA.—A large majority of shareholders in the Dharwar Reefs company have subscribed for shares in the Kabulgitti company, formed for the purpose of continuing operations. Recent exploratory work is reported to be giving more encouraging results, and the graphitic tailing that has given so much trouble is again to be tackled by a modified process. It is announced that the Goldfields of Dharwar, the parent company of the Dharwar district, is to be liquidated, after the payment of a final call of one shilling per share.

FRANCE.—One of the features of the day is the revival of gold mining in France. In May the La Belliere mine produced £16,000 in gold. Fifty stamps are in operation, the weight ranging from 1250 lb. for each of 20 stamps to 1500 lb. for each of the other 30. The mill treats 120 tons per day, crushing to 30 mesh. Plate amalgamation is followed by cyanidation, according to modern methods. During 1909 the production of gold was 30,518 oz. The gold sold during the year was 29,100 oz. producing £124,500 ; in addition 180 tons of arsenious acid was sold for £2168. The profit for the year was £59,946. We are aware that Wernher, Beit & Co. were recommended to investigate some of these French mines, but declined, at a time when their prospects were less favourable. Since then the shares have been 'boomed' in Paris.

CORNWALL.—The exploitation of tin-bearing gravel deposits in the district to the north of St. Austell is attracting attention. Mr. C. G. Lush has an Australian dredge ready for operation. The Marsh Syndicate, under the advice of Mr. F. W. Linck, is testing ground with the Banka drill in the Fowey valley, preparatory to erecting a dredge. It is reported that radio-active pitchblende has been found at Botallack and that some is being sold to Madam Curie.

EDITORIAL

THE MINING AND METALLURGICAL CLUB became a social fact on May 30, for on that day the members foregathered in their new quarters at St. Ermin's, Westminster, and after a felicitous speech from the president, Mr. Sidney H. Farrar, the Club was declared duly open. A large attendance gave promise of keen interest in this enterprise. The rooms are conveniently situated, appropriately furnished, and ample for present necessities. In time we hope to see the undertaking expand so as to warrant the organization of an Engineers Club worthy of London. It is pleasant to record that the club of that name at New York sent its fraternal greetings and has offered to exchange courtesies—an act of hospitality significant of pleasant Anglo - American relations and of more than sentimental value to those whose professional duties may take them across the Atlantic. Undoubtedly the starting of the Club is a step in the right direction ; it makes for solidarity and good - fellowship. May it live long and prosper.

OUR CONTEMPORARY the *Mining and Scientific Press* has recently celebrated its semi-centenary, for it was founded on May 24, 1860. The oldest and, we believe, the most useful mining journal in America will receive congratulations from every quarter of the globe. We send ours. From the anniversary issue just to hand it is apparent that the *Mining and Scientific Press* carries its age lightly, with no trace of weariness ; and the journalism for which it stands seems in itself to be invigorating, for among the contributors to the anniversary issue are no less than five editors, the oldest of whom was in charge 40 years ago. Mr. A. D. Hodges writes with no shaky pen even at this late date but discusses mining affairs with the optimism of a West that looks only to the sunrise. Another veteran, Mr. Charles G. Yale, who was editor of the paper for 23 years, describes some of his experiences at a time when San Francisco was less in touch with nerve centres of the world than she is today, and we know well that in the far corners of distant mining regions many a Californian will rejoice to see that an old and respected friend is still in harness. Indeed the honourable standing of the *Mining and Scientific Press* needs no stronger testimony than the fact that men such as these are willing to give a helping hand. We note that James Douglas, Rossiter W. Raymond, William P. Blake, and S. F. Emmons contribute recollections of the long ago ; their very names are eloquent of the mining and metallurgical progress of North America. This Magazine is not a year old, and, in again felicitating our ancient friend at San Francisco, may we say that we would wish nothing better than ourselves 50 years hence to possess as good a record of honourable achievement and as splendid an array of well tried friends.

To this we add a sad postscript, for William P. Blake died at Berkeley on May 22 at the ripe age of 84, after a career as honourable as it was useful.

IN SPITE of jeremiads about declining British industry, and the financial ruin of the country due to flouting of economics by political parties, the general prosperity is continually advancing, if the figures relating to incomes may be taken as a guide. In a parliamentary return just issued it is shown that the total income-tax returns for the last year for which figures are as yet available, namely, 1907-8, amounted to no less than £799,313,000, and that after the usual deductions, the tax was paid on £671,313,000. During the year 1894-5 the corresponding figures were £551,390,000 and £475,680,000, and from then onward the increase in the figures has been most regular.

Flotation.

We have to thank Mr. W. E. Simpson for sending us a useful contribution on the Potter flotation process. Owing to the rivalry of inventors the exact working details of the various metallurgical methods are not always available. The relative value of the oil, acid, and bubbles as agents of flotation is far from clear, opinions on the subject being modified according to the degree of ownership or claim on the part of the patentees. The physics of the particular processes is not fully understood even by the inventors themselves, and when they attempt to explain the operation of processes other than their own, surmise often takes the place of exact information. We therefore welcome a contribution to our knowledge of the subject coming from a metallurgist who has operated one of the processes as a thorough scientific investigator. It is well to know that while the Potter process was in operation at the works of the Zinc Corporation no oil was ever used nor were the conditions of work such that oil could enter the vats either accidentally or incidentally. He also makes the point that if the ore to be concentrated is charged into the vats dry, instead of being in the form of pulp, much more air will be introduced and the buoyant action thereby increased. We are glad also to have a reminder of the theory promulgated by Mr. A. De Bavay to the effect that gelatinous silica produced in the hot acid solutions may be as effective as oil in the agglomeration of the sulphide particles.

We again plead for the value of public discussion of these little understood phenomena of flotation. The man who knows most already will benefit most by such discussion. The cleverest man will give no handicap. Even better for the advancement of science would be the amalgamation of the various interests at present in antagonism. Consider the advantages of free and frank exchange of views between the chemists and engineers now spending their best energies in devising methods for circumventing each other; particles of knowledge hitherto separated and solitary could be agglomerated by the oil of sweet reasonableness, with just enough acid to give a spice to competitive friendliness, and enough buoyancy to help forward and upward the free flow of concentrated thought. All that is required to effect this desirable result is for some magnetic personality to break down the surface tension between the hostile groups.

Commission on Mining.

We note, with interest, the appointment of a Royal Commission to enquire into the safety and health of workers in quarries and metalliferous mines. It was originally intended that this subject should form part of the scope of the Commission that has been sitting for three years, investigating the dangers incidental to coal mining; but the Government has evidently felt that the subjects are so different as to warrant a change in the personnel of the enquiry. Hence the new Commission, on which we find the names of men identified with iron mines, slate and granite quarries, and Cornish tin mines. We hope this Commission will formulate suggestions designed to lessen the accidents due to falls of rock in Cornwall, and that it will investigate the causes of lung trouble at the Welsh slate quarries. For many years the men in Wales have been subject to pulmonary diseases, and since the passing of the Act saddling employers with full liability for ill health and accidents consequent on the employment, the dispute as to the cause has been acute. The men say it is due to dust, and the employers blame the insanitary and unventilated state of the homes.

The Commission will be able to sift the evidence and act as arbitrator.

New Demands.

At the present time the exploitation of oilfields has created a demand for geologists versed in the scientific search for liquid fuel, and at the same time the increased speculative interest in alluvial deposits containing gold, and also tin, has accentuated the scarcity of those experienced in placer mining. The development of new oilfields in South America, Trinidad, Mexico, the Caucasus, and other regions widely separated, has prompted the flotation of over a hundred new companies during the first quarter of the new year. The oil-flotation process of extracting money from the public is not patented. It is being freely utilized; but not injuriously. Many most promising ventures have been launched under excellent auspices. Similarly the renewal of interest in dredging, in California, Alaska, Colombia, British Guiana, and elsewhere, together with the discovery of valuable tin-bearing alluvium in Northern Nigeria, and large tracts of gold-bearing gravel in different portions of Siberia, have led to a call for those competent to test such ground by drilling and capable of directing the systematic operations that follow successful tests. Hitherto English engineers have paid scant attention to oil exploitation because that mineral constituted a relatively unimportant item in the assets of the Empire. In New South Wales oil-bearing shale had formed the basis for successful mining and metallurgical operations, but the great oilfields of the world were under flags other than our own. Nor had the catholic taste of the London financiers found oil ventures attractive, until Nigeria, Trinidad, Peru, Maikop, and other new fields of industrial activity and financial excitement were presented as the result of important discoveries, themselves due in part at least to the increasing application of oil as fuel, for naval purposes and for automobile consumption.

As regards the other branch of industry in which specialists are lacking, it must be confessed that English participation in alluvial mining had dwindled to insignificant dimensions. The Anti-Debris legislation in California killed many British investments 25 years ago, the companies that were formed during the Klondyke boom have left only wreckage, the gravel mines of Otago, in New Zealand, were among the best in the Empire but they were relatively small affairs and were financed locally, the tin drift in Tasmania served as the foundation for an over-capitalized company that has been a decent failure. Besides these many other abortive schemes all over creation could be instanced, for British capital like a garden sprinkler irrigates a wide area in a haphazard way. Yet, on the whole, a relatively insignificant proportion of the money devoted to mining has gone into placer operations. In part this has been due to the experiences mentioned, in part it is the result of the diversion of engineering talent to other branches of mining; one cause has reacted on the other, until the small number of alluvial mines controlled by Englishmen has led to a scarcity of those versed in this particular subject. It is high time to remedy both conditions; the placers, whether of gold or tin, afford chances for most remunerative operations, and the work incidental thereto calls for the services of competent men. In British Columbia, Alaska, Colombia, British Guiana, Nigeria, West Africa, and Siberia—to mention a few regions prominent just now—the English investor will find scope both for financial and technical talent. One of the great gold mines of the world, the Lenskoie or Lena Goldfields, is an alluvial mine. The Yukon Gold may have been spoiled as an investment by a splashy financial scheme, but the fact remains that it is a richly productive mine. The Yuba Consolidated in California is a dredging venture surpassing in its output and its dividends any lode mine in California and comparable to the best of mining ventures anywhere. We mention these to emphasize the fact that alluvial mining is capable of being expanded to dimensions worthy of the largest financial operations and adequate to give returns proportionately impressive.

The Union of South Africa.

Eight years after the Peace of Vereeniging, which marked the close of four years of warfare between the English and the Boers, the sincerity of the effort to heal a bitter racial controversy has found expression in the Union of South Africa. On the last day of May the Governor General, who is the son of William Ewart Gladstone, joined with Louis Botha, formerly the general in command of the Boer armies against Great Britain, but now the first Premier of United South Africa, in a solemn thanksgiving at Pretoria, precedent to the inauguration of a regime that marks the consolidation of a new Empire under the British flag. The Union of South Africa is an event "more important than Waterloo, Peterloo, or any other battle." If "peace hath her victories no less renowned than war" here is the greatest of them all. We British are a phlegmatic race. We do not know when we are beaten and we do not know when we have won. Crushing defeats are "regrettable incidents" and even the crowning achievement of a pacification that changes a distracted war-scarred country into a happy industrial community is credited mainly to the common-sense of our former enemy. And yet it is superb. To conquer by force of arms is as nothing compared to the winning of esteem and confidence from our old opponents. To bring the Boers to terms by the treaty of Vereeniging was a feat even less glorious than the complete fulfilment of the promises then made. Within four years from the day when the sword was sheathed the Transvaal obtained self-government under a Boer ministry; within eight years of the date when the two races shook hands in token of peace, the States of South Africa have become united, and the Premier called to the head of affairs was the man who had led the Boers in battle. The record glorifies the pages of history; it is an act of national magnanimity of which we Englishmen may well be proud; it is an example of liberality and of Liberalism that sheds undying lustre on the name of Campbell-Bannerman. From the rounded periods of a panegyric to the plain severity of a hyphenated Scotch name may seem an anti-climax, but the contrast serves to remind us that to men not wholly unlike ourselves it is sometimes given, under guidance of sincere purpose and inspired humanity, to perform acts so much finer than those of which the average man is capable that the nation is thrilled with noble purpose and stands reverently while the strains of a *Te Deum* at Pretoria mingle with those that reverberate through the cloistered aisles of Westminster.

Oil in California.

Production of oil in California now exceeds in value that of gold. Moreover, recent discoveries have created widespread interest, as is shown by the letter we publish from Mr. Thos. J. Barbour, who arrived in London a few days ago from San Francisco. We are indebted to Mr. Barbour for a timely account of the oil industry in California. Evidently the gusher at Lake View is comparable to the Beaumont in Texas, the Drouba, at Baku, or the Maikop, in the Caucasus. For three months this well has ejected oil at the rate of 42,000 barrels, or 6000 tons, per day. The oil spouted to a height of 130 feet and diffused its spray over an area of several miles. The casing of the bore-hole was early worn to nothing by the oil-sand and the diameter of the hole was enlarged to 12 inches: it is now estimated to be at least 10 feet wide. All vegetation within range is blackened and killed, producing a dreary landscape. Persons approaching the gusher wear rubber suits, the use of which under such conditions suggests how oil and rubber may be 'boomed,' in London, concurrently. Owing to the danger of igniting the gas that escapes with the oil, it is found necessary to employ armed guards to keep automobiles at a distance. A new pipe-line is projected, that already tapping the Midway oilfield having a capacity of only 25,000 bbl. per day. Such a pipe-line, 200 miles long, to the coast, will cost $5,000,000. At present the pipe-lines from the Coalinga field have a combined capacity of 67,000 bbl. per day, while those to the Kern, the Mackittrick, and Midway are able to carry 136,000 bbl. per day. As yet this liquid fuel has not stimulated manufacturing as much as might be inferred, but when the local supply of oil becomes assured at a reasonable price we shall expect to see a marked impetus to general industry in California.

Dredging for Gold.

We are glad to publish another letter in defence of dredges designed and manufactured in British territory. Mr. C. W. Purington sounded the slogan for the American machine and Mr. W. H. Cutten takes up the cudgels for his side in the controversy. The discussion is useful for the information it elicits and for the voids that it discloses. We need facts, and we need something more, namely, that technical men shall avail themselves fully of such data as are at their disposal. It is painful, when it is not ridiculous, for engineers and operators to engage in a special branch of mining, such as dredging for gold, without making the utmost use of the information published from time to time in the technical Press. But they do not. Here we have Mr. Cutten, who rightly claims to be a specialist, discussing dredging in Alaska and writing concerning a particular dredge in Alaska as if both had never been described in detail by a competent writer in the *Mining and Scientific Press.* The letter quoted by Mr. Purington, and criticized confusedly by Mr. Cutten, was written by Mr. W. L. Leland, the manager of the Three Friends dredge, working on the Solomon river, near Nome. This should have been known to Mr. Cutten, who ought also to be familiar with the conditions under which the Three Friends dredge is operating, because those conditions have been described fully in a technical paper that anyone ought to read who undertakes to build dredging machinery or to advise others how to build and erect such machinery. If he had he would have known that the "hard conditions" do not involve frozen ground, although they do refer to a bedrock of limestone. The "successful operator" is a very different kind of person from Mr. Cutten's "self-styled dredging expert," for Mr. Leland, the gentleman in the case, is one of the most competent dredge-masters anywhere to be found. The small percentage of time lost by Mr. Leland referred, of course, to the season, not the year, for in Alaska digging is not possible except during the summer months. In 1909 the Bear Creek dredge, in the Yukon, lost only 7·9% of the total time available, which was from May 9 to November 20. During that period 681,616 cubic yards were removed, an average of 3558 yards per day, at a total cost of 15 cents per yard. We wish to be fair to Mr. Cutten, who, as a disputant, himself adopts a courteous tone and gives many items of useful information; for example, our readers will be grateful to him for correcting Mr. Shockley, who credited the successful dredging on the Tagil to American machines while it was the work of dredges of the New Zealand type, built in England. But it does seem futile to compare British and American dredge-building by contrasting the New Zealand dredges with the Oroville company's equipment. The machines in Otago and Southland are small and are operated in a small way, quite unsuited to the financial excursions that form the basis of company promotion in London. In 1909 the total output of the dredges in New Zealand was only 42,467 ounces, won by 110 machines. This small average yield is due to the fact that the Government regulations forbid a dredging company to control more than one mile along a river, or more than a tract of 100 acres, except in cases where the valley is narrow, when a maximum length of two miles, but not exceeding an area of 40 acres, can be exploited. Such restrictions, of course, are a hindrance to operations on a large scale. One dredge may prove a profitable machine, but in countries where the season is short or delays frequent, it is absolutely essential not to risk loss of time and productive opportunity by employing only a single machine. A tract of ground that will not warrant the employment of three dredges, after the first one has been tested in regard to local conditions, usually does not afford the basis for sound business from a London company's standpoint. To return to our text; it is misleading to make comparisons with American practice on the basis of the Oroville company's operations; these do not illustrate the most successful work done in California nor do they illustrate the most advanced form of the American method. But up-to-date American practice has been described in detail and the details are available to those interested in the subject. Again we say that those who assume the role of specialists ought to keep in touch with the advancement of knowledge in their subject and that we have no patience with technical men who deny themselves the assistance rendered available by periodical literature.

In our May issue we published a letter, eminently courteous and sensible, by Mr. P. Goedkoop, in which some of Mr. Purington's arguments are traversed. This letter is both suggestive and informing. Some of the reasons for failure are mentioned by way of warning, and attention is drawn to the necessity for adapting machinery to local conditions. Undoubtedly the improvement of design in American dredges is due to the collaboration of practical operators with constructing engineers, and the application of past experience to future needs. That is the way to success. If dredging has failed to make money for British investors it is not due to the failure of British machinery but to the splashy manner in which dredging enterprises are financed, whereby the cheerful probabilities are fully capitalized and the unhappy possibilities are confidently discounted. Many tracts of dredging ground that would yield a handsome return on a reasonable purchase-price, if operated in a quiet way by experienced men using their own knowledge and also that obtained from technical publications — may prove unremunerative if capitalized on the basis of possibilities as seen by inexperienced speculators and if operated by engineers who utilized the opportunity to get their first experience in this branch of mining. Dredging for gold as a legitimate form of industry has suffered because people play the fool and then expect miracles to happen.

Screens.

Two interesting and valuable papers on the subject of the screen-analysis of crushed material were presented at the last meeting of the Institution of Mining and Metallurgy. The papers were entitled 'A Standard Series of Screens for Laboratory Testing' by Mr. Theodore J. Hoover, and 'Grading Analyses and their Application,' by Mr. H. Stadler. By a coincidence not uncommon in scientific investigation two engineers in different parts of the world simultaneously evolved a new idea, and their two papers covered the same ground. At present two standard series of screens are recognized, one promulgated by the Mines Trials Committee at Johannesburg and the other by the Institution of Mining and Metallurgy. We need not recapitulate the details of these series as they are well known. Both are the result of much labour in research and consultation, but, as is usual when large committees sit to consider a subject, the recommendations are not consistent. This defect is inherent in committee work. Some members may not have devoted special attention to the subject under discussion and they have neither the time nor the inclination to remedy their deficiency. Others care nothing for refinement of scientific research, priding themselves rather on being practical men. If the sittings are prolonged, the personnel of the committee changes, and those who spend most of their time near the place of session naturally dominate. The decisions and recommendations are apt to be illogical. To say that a certain set of screens was adopted because a committee recommended them is no reason at all. Moreover, even if a body of men, acting in the light of the knowledge available at the time and having in view a field of application limited to the engineering requirements of the day, adopt a series of screens we may question whether their decision must be accepted as final for all time. If circumstances alter, if new applications are found, or if some inventive man comes forward with an ingenious proposition, the opportunity is offered for a review of the official position. At any rate the question should be debated fairly and the arguments against change should be advanced in an unprejudiced manner.

Approaching the subject under different conditions, when studying different problems, the two authors ascertained the advantage of using a set of screens giving a series of sized products of which the average weight or volume of the constituent particles in each member of the series is just one-half of the next larger size. Mr. Hoover approached the subject by way of the flotation process and Mr. Stadler through the calculation of the power required to comminute ore in various types of crushers. Many attempts have been made in former days to deduce a set of screens that would give a series of products the constituents of which bear a fixed ratio in size to each other. In Rittinger's series the areas of the apertures were arranged in a fixed ratio of 2 : 1. Mr. De Kalb proposed that the set of screens should have apertures with a common difference of 0·001 inch. Neither of these series has a sufficient number of screens within the usual range of investigation into fine grinding. The screens adopted by the Institution of Mining and Metallurgy form a useful and convenient set, but there is no definite relationship between the members of the series. The ratio between the weight and the volume of the particles in each division of the Hoover and Stadler series being as 2 : 1, it follows that the proportion of their linear dimensions is the cube root of two. Starting with an inch aperture as a base of operations, it is necessary to divide by the cube root of two as many times as the number of screens required. In our Précis of Technology we give the resultant table of apertures and the corresponding series of meshes per inch. In the Précis we also refer to the strange relationship between the aperture figures in inches and millimetres.

In his paper Mr. Stadler explains the application of his set of screens to the calculation of the work done and the efficiency of various crushers. This subject is continually debated and at the present time forms the basis of the argument between stamps and tube-mills. Full justice has never been done to crushing machines. It is not sufficient to say that a machine will reduce ore to 60-mesh when one-half will go through 90 and a quarter through 120-mesh. Mr. R. W. Chapman, of Adelaide University, was, we believe, the first to separate the product into sizes, estimate the relative power required to produce each size, and add up the total power. He assumed that the power required to reduce a particle from one size to another was proportional to the difference in the reciprocals of their linear dimensions, and he considered that for practical purposes the mesh could be substituted for these reciprocals. His proposal therefore was that the proportionate amounts of the various sizes should be multiplied by the mesh and the products added together. This figure would give an idea of the amount of work required to produce the comminution. If this figure for the supply is subtracted from that of the discharge, a figure is obtained corresponding to the work to be done in the crushing operation. If this figure is multiplied by the tonnage per day and divided by the horse-power employed, we get a figure indicating the relative efficiency of the machine. Mr. Stadler works on the same lines, but he takes the power required to reduce one size to another to be proportional to the relative amount of reduction. This is the proposition formulated by Kick. Mr. Stadler takes an energy-unit equal to the power required to reduce the volume of a particle by one half, and his screens being adapted to this scale, he is able to use the ordinal numerals as indicators of the power required to produce material going through each successive screen. Multiplying each of such numerals by the percentage going through the corresponding screen and adding them, multiplying by the total tonnage and dividing by the horse-power, he gets his figures for the relative efficiency of the machine. This proposition deserves close attention and we shall revert to it on another occasion, but it is well to point out that both Kick's law and Mr. Chapman's assumption require further investigation; although either of them will give an idea of the relative efficiencies of machines, there is no certainty that either gives the actual efficiency.

The objections to the 'cube root of two' series of screens urged at the meeting had no bearing whatever on their efficiency or practicability. Every objection was equally applicable to any other set of screens, including that of the Institution itself. Objection was made to a refinement quite useless in ore-dressing practice, but it is a fact that the screens are intended primarily for research. Other objections were that the wires could not be interlocked so as not to shift, so vitiating the classification, and that wear and tear introduced variation. But cannot the same argument be used against any sort of screening? Other speakers imagined that, because cubes were used in one of the diagrams to represent the successive sizes, the authors assumed that the particles are all cubes, forgetting that the law is equally applicable to any other form of particle. It was objected also that engineers and workmen cannot think in five places of decimals in connection with apertures, and that therefore the number of apertures per linear inch with a wire the same width as the aperture is the only practical basis of screening. Without unduly labouring this point, we consider the intelligence of the engineer and skilled workman quite equal to this mental strain; and for the unskilled workman, why not use Mr. Stadler's ordinal numerals? Besides, there are some reasons why apertures should be employed, the most obvious of which is that finer wires can then be used for the coarser screens. With any screen up to 30-mesh a finer wire could be used. Having a wire as wide as the hole means that only 25% of the surface is available for screening, with the consequence that operations are longer than they need be, the wires become unduly worn, and the particles become additionally triturated so as no longer to represent a fair sample of the material. To introduce improvements obviating these drawbacks means forsaking mesh for aperture.

In offering this criticism of the critics, let it not be supposed that we belittle the Institution's service to standardization. Although the official recommendations are founded on an empirical, rather than a scientific basis, the Institution has done excellent work in procuring screens of dependable workmanship and in founding a standard that wherever used means the same thing and conveys the same idea; but having done this useful service the members of Council should hesitate to riddle the ingenious propositions of outsiders with irrelevant arguments.

Heavy Stamps and Tube-Mills.

The paper by Mr. W. A. Caldecott on the development of heavy stamps read before the Institution of Mining and Metallurgy has provoked valuable discussion both in England and in South Africa. As a record of what had been done in the way of experiment on the Rand it was of immense value, and it has served the further useful purpose of eliciting comment that advances us along the road of knowledge. Both the paper and the discussion have clarified ideas about comminution, and in all probability they will form the first stepping-stones to a new line of investigation. In particular, we would call attention to the contribution of Mr. Edward J. Way, an abstract of whose remarks is found in our Précis of Technology. Mr. Way is a man of independent views, and is one of the few prominent engineers on the Rand unconverted to the tube-mill. At New Kleinfontein crushing is still done by stamps and Mr. Way shows in his figures that the cost of reduction is as low as, or lower than, that at the other mines. He is also consulting engineer to the Benoni mine, which adjoins the Kleinfontein, where he has recently erected a new mill with 2000 lb. stamps, which crush to four holes per square inch, together with tube-mills, in the ratio of 1 tube-mill to 13¾ stamps, this being the coarsest crushing by stamps and the lowest ratio of stamps to tube-mills yet adopted on the Rand. Naturally he has been accused of inconsistency, but he explains that he was induced to prepare the Benoni plans during an interval of conversion to the tube-mill idea, induced by preponderating local opinion and the results of some of the trials. As we are all merely learning the elements of crushing efficiency we have no stone of criticism to throw at Mr. Way for being of an open mind. Indeed we consider it a fortunate circumstance that a man so unprejudiced should have this unexampled opportunity of working the two systems side by side.

The evolution of the heavy stamp has been due to the need for coping with huge supplies of ore. It was taken for granted that large installations meant large individual parts, and that a heavy stamp could do more work than a light one. It has been known, however, for a long time in a general way that heavy stamps are inefficient for fine crushing; more recently it has been shown that for each weight of stamp there is a corresponding mesh ensuring maximum efficiency; the heavier the stamp the larger the mesh. When stamps weighing more than 1000 pounds apiece were introduced, it became evident that they would have to be supplemented by some other machine for the finer reduction; this led to the introduction of the ball-mills used in cement-grinding. Current practice on the Rand now is toward still heavier stamps with large duty and an increase in the tube-mill outfit, it being found that less power is consumed by the new arrangement. Credit is being taken by the advocates of the tube-mill for this alteration in policy and the accompanying lower cost, but we do not look at it in that light. A heavy stamp crushing fine is more uneconomical than a tube-mill; or, in other words, it is wrong to apply a coarse crusher to work for which it is not fitted; it is proper to use a tube-mill for fine grinding, because it was designed for that purpose, even though its efficiency may not be high. By stating the proposition in this way we are able to show conversely that if the weight of the stamp be adjusted to the aperture required, the efficiency of the stamp-mill may be as great as, or even greater than, that of the tube-mill. The inefficiency of both stamp-mill and tube-mill arises from the inability to remove the product directly it is fine enough. By using a coarse screen the finer particles are more easily discharged and even with the coarsest screens much of the product of the first two or three blows is sufficiently fine for the plates or for cyanide treatment. This fact, together with sizing of the pulp in its passage from the stamp-mill to the tube-mill, makes for the efficiency of both. But the same advantage would be gained if, as Mr. Way points out, the tube-mill were replaced by a light stamp-mill treating the sized product of the heavy stamps. A trial of a combination of light and heavy stamps in competition with heavy stamps and tube - mills would be of great interest and would probably lead to the modification of many ideas. On the other hand, the adoption of the conical form of tube-mill should conduce to efficiency, for it discharges the material when reduced to the requisite fineness much quicker than the cylindrical tube-mill. It is apparent, therefore, that plenty of scope remains for experimental work in comminution and we shall expect to see such experiments made on the Rand.

Lead Poisoning.

The Home Office has issued a report on the dangers incidental to the smelting of lead ores, with a view to framing regulations for the prevention of poisoning in the manufacture of lead products. In the United Kingdom no less than 34 lead smelters are at work, besides 8 zinc-distilling plants, and many factories for the production of paints and other metallic compounds. Although special regulations have been enforced by the Government, the effects of lead poisoning have not been mitigated. This is more notable because since the Workman's Compensation Act came into force three years ago the men known to be liable to the disease have been removed from this dangerous occupation. The report, which is by Mr. Edgar L. Collis, a medical inspector of factories, indicates clearly that greater precautions are needed to overcome the evil effects of dust and fume. In consequence, he has recommended additional restrictions, and these have been submitted both to the Home Office and to the owners of smelting works. He suggests the further dampening of floors and of ores wherever practicable, and advocates provision of draught-hoods to remove the fume when moisture cannot be applied ; for instance, he advises that all floors be watered with a hose and that all leady material be kept damp unless it can be stored in an isolated place, and that the furnaces be charged automatically so as to prevent escape of dust. When such precautions are not possible, it is desirable to supply hoods with suitable draught, as in charging zinc-retorts, tapping lead-furnaces, melting lead, and so forth. When re-constructing furnaces, flues, condensing-pots, and the like, these structures should be cooled and damped, and nobody is to be allowed inside them without clean respirators and overalls, nor remain there for more than three hours at a stretch. These obvious precautions should certainly be enforced. For instance, the Faber de Faur furnace for removing zinc from lead bullion necessitates the use of a high temperature ; much lead therefore is volatilized, but this particular apparatus has the disadvantage of not accommodating itself to the adjustment of a draught-hood. In the distillation of zinc, now that so much of the concentrate has a high lead-content, extra precautions should be taken to prevent the dispersion of any lead. Attempts are being made to employ filters for this purpose, but the danger lies not so much in the escape of the lead through the condenser and nozzle, as from the residue obtained when ore rich in lead is being treated, containing both lead and zinc ; for, when such material is discharged, it is apt to fill the works with dust and when ejected on the dump it is blown about so as to be a constant cause of disease. We would extend these recommendations to the concentration of lead ores, and suggest that the preliminary crushing and sizing should be performed dry. Magnetic concentration of ores is usually done dry and is known to be particularly noxious. When only concentrate is being treated the plant is comparatively small and can therefore be conveniently enclosed, but otherwise such a precaution is impracticable. When concentrating lead ores magnetically it is necessary to use respirators and care must be taken not to remove them in order to speak. We know a case of a mining engineer who became a victim to lead poisoning simply because he repeatedly removed the respirator when giving instructions to incompetent workmen. Such an investigation as that instituted by the Home Office under the direction of Mr. Collis, together with the ensuing recommendations, may not interest many and may annoy more, but such beneficent effort is deserving of hearty support among professional men, for the care of human life is a basic principle of economics.

Theodore Roosevelt.

The tour of the ex-president of the United States has proved as interesting to the people of Europe as it was to the wild animals of Africa. His accuracy with the rifle disturbed the hippopotami and rhinoceroses of the spacious wilderness not more than his incisive criticism has perturbed the stalwarts of a deeply encrusted civilization. To many most worthy, if slightly narrow-minded, persons the former colonel of the Rough Riders has appeared an irritating phenomenon and to them his copious admonitions have proved unmistakably unpalatable. It is Mr. Roosevelt's privilege to awaken the reactionary and to stir the complacent. But it has also been given to him to perform a function of greater utility. He is the prophet of the obvious. By force of character and vigour of utterance he reanimates platitudes and endows them with the radioactivity of his own strenuous vitality. The half-truth in large print and the simple message in rounded periods impress even those who are not his countrymen because the speaker is known to be the practical exponent of his own virile teaching. It is the man behind the gun that makes the verbal artillery effective. Some of it may seem only sonorous but much of it is deeply penetrating, even to the steel-plated superciliousness of a self-satisfied Britisher. With the insouciant courage of a man overflowing with good health and spirits, confident in himself and sure of his message, he comes to the complex civilizations of the Old World like a gusty breeze at the dawn of a new day—the day of social reform and democratic government. We may object to the over-confidence of the great American lecturer but we cannot deny that his very assurance is more potent for good, for progress, and real development of national character, than the faineant philosophers masquerading as statesmen who see so many aspects of each problem that they fail to envisage the problem itself. It is true that a sardonic smile has crossed the face of Europe when listening to the insistent orations prepared more than a year ago and now delivered in the presence of royalty, scholarship, and statecraft, but the earnestness of the emphatic speaker, who shoots lions at Nairobi as coolly as he meets those of another species at Berlin, is vastly more effective than the unemotional propriety of those who have so keen a sense of humour that they are afraid to incur ridicule and are so anxious not to seem absurd that they meander through life in dignified inconsequence. No such timidity cripples Mr. Roosevelt; unhindered by the fear of derision, not careful about repeating himself, unmindful of his pose, this outspoken protagonist of the realities goes to the heart of sociological problems, using the blunt tool of sincerity and the strong sword of common sense. He calls upon the modern man to take another forward step in ethical progress by insisting less on the rights and more upon the duties of the citizen; he takes the emphasis off class privileges and puts it on the sense of responsibility; he appeals from self-gratification to disciplined character. This was the teaching of Huxley, who repeatedly illumined the fact that natural right, according to the gospel of Rousseau, might apply to the tiger in the jungle at the beginning of the cosmic process of evolution, but was inimical, because anti-social, to the ethical development that is destined to kill the ape and tiger in man, rejecting his brutish heritage and enabling him finally to win the imperishable ideal of equality of opportunity. That American ideal is the supreme effort to make existence intelligible and to reconcile the moral sense of humanity with the brutal facts of natural life. From our remote ancestor, the tidal ascidian, there has been evolved, slowly and painfully, the social man. Jean Jacques Rousseau imagined a vain thing, Thomas Henry Huxley bequeathed to us his scientific concept of human progress, and Theodore Roosevelt now hammers our intelligence with the sociological aspect of the vital problem. He accepts conditions as he finds them, in order to improve them; he is no dreamer, but a performer; an examplar as well as a teacher. He has proved to the American people that to be practical it was not necessary to be corrupt. It was a lesson they needed. He is the embodiment of the best of American ideas. Of course, the turgid rhetoric, the passion for big things, the self-reliant energy, and the vivid frankness are all intensely American; these characteristics impinge sharply on the dry surface of European thought, like rain on the *caliche* of Arizona, and these characteristics would be only annoying if they were not the outward signs of a character, personal in Mr. Roosevelt and national in the United States, that has given splendid momentum to an industrial and political development such as the world has never seen before. To those perturbed by the growth of the democratic spirit in Europe, to those faint-hearted in the endeavour to remedy social injustice, to those uncertain as to the tendency of this complex mode of living we call civilization, there comes this robust thinker and confident prophet, and his hoarse voice, by aid of the printing press, is more stirring to men's minds than any bugle blown by gilded herald. We accept him as a sincere exponent of the American idea, as a living demonstration of honesty in democratic government, as a social reformer of tremendous influence on his day and generation, and most of all we accept him as the embodiment of the political youthfulness and resourcefulness of a great people. His faults, like those of his country, are those of youth; his charm, like that of the United States, is utter lack of boredom; his gift, like that of America, is to vivify creation.

Iron Resources of the Transvaal.

The Government of more than one South African State has recently sought the advice of an English specialist with regard to the development of the ore deposits within its boundaries. We referred in our April issue to the report presented by Mr. F. H. Hatch on the mineral resources of Natal, and we have now before us the report by Mr. F. W. Harbord on the possibilities of establishing an iron and steel industry in the Transvaal. As far as present developments are concerned Mr. Harbord is not much more optimistic than Mr. Hatch, but his view of future possibilities is more encouraging. In our Précis of Technology we give an abstract of Mr. Harbord's report, which supplies information supplementary to the preliminary data on the subject published in our issue of September last. Iron ore is found in various parts of the Transvaal and is classed under three heads: The titaniferous deposits containing 45 to 47% iron, 13 to 19% titanium, and low in silica; the magnetic, high in silica, and containing phosphorus; and the hematite, of which parts are pure and rich in iron and parts consist of a hematitic shale containing not more than 11% silica. The outcrops impressed Mr. Harbord with the idea that the deposits are extensive, but prospecting and development has been insufficient to warrant a decided opinion. As a practical man he lays stress on the fact that no iron-smelting industry can be successfully founded on anything but large and thoroughly proved deposits. A furnace of medium size requires over 100,000 tons of ore per annum and even a plant of moderate capacity would call for 300,000 to 400,000 tons per annum. Also before spending capital on such a plant, it would be necessary to have the assurance of a ten years supply. At the present time there is no definite indication of such resources, but Mr. Harboard is of opinion that systematic development and investigation are warranted.

As regards the adaptability of the various ores for smelting purposes, Mr. Harbord does not favour the use of titaniferous ore. Such ore has formed a bone of contention among metallurgists, some saying that the slag formed is too refractory for practical purposes while others use mixtures with success. He is inclined to believe that the objection to such ores is mostly founded on prejudice and the misunderstanding of the chemical action of the titanic acid, but on the other hand he is not prepared to suggest that the Transvaal should embark on experimental work. The silicious magnetite seems to him to be the most promising, for though of a quality inferior to the hematite, it occurs in larger quantities. The high content of silica would make the smelting expensive ; but the iron produced would be suitable for foundry purposes and for the manufacture of steel by the basic process.

The other constituents of the smelting charge, limestone and coke, necessarily form part of the economic problem. Suitable limestone deposits are of limited extent and consequently the cost of mining is high. There is no evidence yet that a hard metallurgical coke can be made from local coal, and in any case the coke would not be of good quality. Also the cost of production would not be low, because, in mining the coal, care would have to be taken to extract only the most suitable parts.

Mr. Harbord's conclusions are that without a substantial bounty and without a guarantee of a regular demand from the railways and other large users, it would be impossible to establish an iron industry in the Transvaal. His opinion on the use of the electric furnace for making high-class steel from the accumulated scrap is that a small plant should give excellent results, but this industry would necessarily be confined within narrow limits and would be of little influence on the general prosperity of the country, compared with the establishment of an industry founded on local ores. His advice to the Government, put shortly, is therefore that systematic prospecting for large bodies of good ore should be encouraged in every way and that investigations should be conducted with a view to the production of a satisfactory coke from local coal.

The report is a valuable contribution to the economics of mining and metallurgy. It is a plain unvarnished tale, like Mr. Hatch's, useful to the country but of no help to the promoter. We hope to see an iron industry founded in the Transvaal. Such an industry is of greater value to the community than that of gold mining, for it would attract permanent residents, instead of a transient population, and it would enrich the Afrikanders instead of merely providing profits for European investors and speculators. After all iron is the back-bone of industry. The United States, though rich in gold, silver, copper, lead, and zinc, would not be a prosperous and settled country absorbing immigrants from other countries if it had lacked resources of iron ore. Germany began to be an important commercial country when it forsook internal strife and devoted itself to the development of similar ores by the basic process. Australia and South Africa can never be independent, rich, and populous countries until iron industries are established within their boundaries. The old saying of Solon to Croesus is still true: "Gold will never save you; if your neighbour has more iron than you, he will conquer you and take your gold." Solon referred to iron in a military sense, but the dictum is true in a broader sense, as applied to industry.

New Registrations.

The registry office for companies, at Somerset House, is crowded in these days, as might easily be inferred from the appearance of the daily and financial Press, the pages of which are enriched, in more senses than one, by the prospectuses of new companies. Only four years ago the Company Law Amendment Committee, over which the Lord Chancellor presided, presented a report in which reference was made to "the recent diminution of company registration." That seems long ago, for today a total change has passed over the aspect of company finance. Neither the stamp duty, nor the provisions of the Companies Acts, nor the allurements of Guernsey, nor any other of the several causes operative in times of stagnation has sufficed to diminish the renewed activity of the promoter. In these cheerful days if you go to Somerset House you will see a long line of solicitors and secretaries waiting their turn to file documents recording the birth of new enterprises. In 1901 the number of new companies registered was 3132; in 1909 the number increased to 5800; but in the first quarter of 1910 no less than 1750 had been registered, this being at the rate of 7000 per annum. And this increase is not due to the rubber boom, for only 150 companies devoted to that industry are among the 1750 issues recorded in January, February, and March. The present speculative fever has invaded a variety of industries; undoubtedly the facilities for gambling have been increased by the overdue income tax, about £23,455,000 of which has been temporarily withheld by the postponement of legislation authorizing collections under the Budget. Another favourable factor is the popularity of the 'private' company, to which we made reference in February. 'Private' companies are parnerships organized as corporations in order to obtain both the protection of limited liability and perpetuity of administration. By the Companies Act of 1908 this type of company obtained statutory recognition; it must not consist of more than 50 persons and it may not appeal to the public for capital, but the chief advantage is exemption from the obligation to present a balance sheet. Two persons suffice to form a private company, hence the necessity for nominating dummy directors is obviated. It is not strange that this form of limited liability is popular, although it remains to be proved how far the exemption from the publicity of a balance sheet has removed a safeguard. Five years ago the registration of public companies in Guernsey resembled the American custom of registering in New Jersey; but the Channel Islands went out of fashion as soon as the financial Press began to publish particulars of the registrations in Guernsey. The opportunity for concealment was spoiled, and when the Companies Act of 1907 compelled every corporation, even though registered outside the United Kingdom, to file certain particulars and disclose its place of origin, then registration at Guernsey was abandoned. Of course, all companies do not appeal to the public for funds, for the underwriting of capital by private subscription is successful in many cases, yet the law compels the prospectus to be filed and in other cases necessitates the filing of a statement at Somerset House. Thus the registrations are enormous and, as *The Financial Times* points out, will demand provision for enlarged accommodation, since 330 yards of shelf-room are required annually for new registrations only. All of which accentuates the fact that London is still the great financial centre.

PERSONAL

W. J. BARNETT has returned from Chile and Peru.

A. C. BEATTY is expected from New York.

L. P. BOWLER is manager for the Cobra Banket Co., near Sekondi, West Africa.

L. N. B. BULLOCK, who returned recently from West Africa, was in Paris during May.

H. KENYON BURCH, mechanical engineer for the Miami Copper Co., recently travelled by automobile for 900 miles through northern Mexico and southern Arizona.

JOHN M. CAIRNS has returned to Glasgow from Colombia.

A. O. CAUTLEY and G. B. BUTTERWORTH are returning from Madagascar.

R. H. CHANNING has been making an examination of the Comstock mines.

C. W. CHATER is examining wolfram and tin deposits in Lower Burma.

J. H. CURLE has returned from Algeria.

W. H. CUTTEN sailed on May 25 for British Guiana.

GEORGE E. FARISH is in Alaska.

ROWLAND FEILDING was in Italy recently.

HAWXHURST & WOLFF have taken offices at Salisbury House, London Wall.

C. S. HERZIG is examining the Porcupine district, in Ontario.

J. POWER HUTCHINS has recently visited St. Petersburg.

P. A. IVANOFF, manager of the Kyshtim mines, is here on a visit.

ALFRED JAMES is due to arrive shortly from Mexico.

RONALD JOHNSTONE, Jr. left London on May 26 for New South Wales.

CHARLES H. JONES has gone to Broken Hill, in the interest of the Murex Magnetic Company.

H. W. LAWS, engineer to the Niger company, has returned from Nigeria.

A. D. MACDONALD has been appointed superintendent for the Australian Maikop Oil Co. in the Caucasus.

J. H. MACKENZIE was recently at Matagalpa, in Nicaragua.

H. K. MASTERS left London on May 28, and is now in Italy.

L. J. MAYREIS is examining mines in Bolivia.

W. W. MEIN has been taking a holiday in Scotland.

C. ALGERNON MOREING left on June 6 for Maikop, in the Russian Caucasus.

HORACE G. NICHOLS has gone to examine gold mines in the Irkutsk region, Siberia.

CYRIL E. PARSONS is now at Bulawayo, with the Rhodesian Exploration Company.

F. P. PAUL, professor of geology in the School of Mines of New Mexico, was in London on his way to the Continent.

C. W. PURINGTON sailed from San Francisco on May 31, for Eastern Siberia.

W. H. RADFORD passed through London on his way to the Lena district, Siberia.

JAMES ROBERTS, formerly superintendent to the Dharwar Reefs Co., has returned to Cornwall.

LEO VON ROSENBERG, of New York, who was recently in Peru, is now in Georgia.

S. F. SHAW has returned from Costa Rica to Los Angeles.

HAROLD SHARPLEY has returned from Brazil.

HOWARD D. SMITH has returned to London from an expedition to French Guinea.

S. J. SPEAK, of Hooper, Speak & Feilding, is on his way to Western Australia and from there intends going to Singapore.

R. ARTHUR THOMAS has been nominated a member of the new Royal Commission on Mines.

C. V. THOMAS was injured in a motor-car accident on May 15, but he has recovered satisfactorily.

J. B. TYRRELL has been elected president of the Canadian Institute.

WALLACE & SUMMERHAYES have moved to the Trust Building, at El Paso, Texas.

P. B. WAUGH is in Northern Nigeria and will remain there for several months.

D'ARCY WEATHERBE left on June 8 for his new post in Eastern Siberia.

STUART S. WEBB-BOWEN is at the Prestea Block A mine in West Africa.

GARDNER F. WILLIAMS has received the honorary degree of Doctor of Laws from the University of California.

LEWIS T. WRIGHT left London on May 18, returning to San Francisco.

SPECIAL CORRESPONDENCE

News from our own Correspondents at the principal mining centres

VALPARAISO.

Poderosa of Collahuasi.— Dissatisfaction is expressed by the original Chilean shareholders in the old Poderosa company who exchanged their shares for those of the present company when it was formed in November 1908. Unfavourable rumours are rife as to the present condition of the property and it is hoped that the general manager, C. H. Mac Nutt, may soon be able to make a public statement concerning the condition of the mine.

Gatico.—This property was under bond to a French syndicate, but the deal was not completed. The company owning the mine at present is said to be making a profit from operations, paying off its debts, and in a generally prosperous condition.

Tocapilla.—The smelting plant erected at this point by the Sloman Co. was evidently premature and is not at present in operation. The owners are now said to be developing mining properties under their control and purchasing mines to supply ore to the smelter.

Caldera.—The smelting plant owned by Edwards & Co. at this port is operating at less than half capacity, owing to lack of ore supplies. The new steam-power equipment is in course of construction and pending the completion of the plant intended to supply power to the blowing engine operating the converter, the matte produced, of an average grade of 47% copper, with low gold and silver contents, is being converted into bars at the smelting works at Lota and at Guayacan, under an arrangement whereby these smelters agree not to compete with the Edwards plant for the purchase of ores at Caldera. It is not known whether the Edwards company expects to convert its own matte when the new power-plant is completed or to continue the present arrangement, but the latter course seems the more probable.

The Copiapo Mining Co., owning the Dulcinea mine and a smelting plant near Puquios, 140 kilometres from Caldera, will be greatly aided by the opening of the Federal Railway connecting their smelter with the Chañaral district, from which this company expects to be able to secure sufficient sulphide ores greatly to improve the smelting mixture. At present the character of the ores smelted is such as to require a high proportion of coke and flux: Smelting, therefore, is expensive. With the addition of sulphide ore purchased in the Chañaral district it is expected to improve the charge and expedite the working of the blast-furnace, so as to show a profit on operations even at the present low price of copper.

Coquimbo. — The Central Chile Copper Co., with mines and smelters at Panulcillo, 76 kilometres from the port of Coquimbo, in 1909 produced 2150 tons of copper in the form of 48% matte, which it shipped to the American Metal Co. for refining at New York. This company is one of the very few corporations in Chile that can show an operating profit at the present low price of copper; its mines near Panulcillo and its smelter are well equipped and in excellent condition.

Almaguer, in Southern Colombia.

The Sociedad Chilena de Fundiciones, owning a smelter at Guayacan, a small port adjacent to Coquimbo, is the largest shipper of copper bars in Chile, its output for 1909 being reported at 7233 metric tons. This copper is all produced from purchased mattes and ores, the plant is old and poorly equipped, and its operations are expensive. It is probable that it is losing money on the present price of copper.

La Serena.—The small smelter owned by the C. J. Lambert Estate at La Serena, and called La Compania, is still operating on a small scale but is under option to a resident of Serena at a low figure. The option covers all the mining property of the estate, including the famous old Brillador mine, from which Mr. Lambert took a fortune variously estimated at from one million to three millions sterling. The construction of the 'Longitudinal,' or north and south railway, through the province of Coquimbo will do much to revive the mining industry in the department of Illapil and Combarbata, where it is at present practically dead, owing principally to lack of transportation facilities.

The estate of Carlos J. Lambert has been sold to M. A. Floto, a wealthy brewer of La Serena. It is reported that Mr. Floto will continue to work the mines and also to operate the smelter at La Compañia, near Serena. For some years past the production of this plant has averaged 30 to 50 tons of copper monthly and there is very slight probability of any future increase in its output as the smelter is antiquated and quite unable to compete with the Panulcillo and Guayacan plants for custom ores.

Atacama. — The 'Sociedad de Minas y Fundiciones de Carrizal,' operating mines and a smelter at Carrizal Alto and Chañarcitos, produced 1762 metric tons of copper during the year ending October 31, 1909, in the form of matte containing 42·07% copper. This production was 198 tons in excess of the production for the preceding year and a profit was shown on operations. The company, which is owned partly in England, though the dominant interest is Chilean, is considering the erection of a new furnace at Polvareda, a point much nearer to its mines than the present plant, to be connected with the mines by an ærial tramway. The installation of a hydraulic power-plant on the Copiapo river is also proposed.

Graneros. —The Braden Copper Co. is continuing active development both underground and on the surface, and will be the first low-grade copper deposit to be developed on a large scale in Chile.

General conditions in Chile are adverse at present. The lack of transport facilities is an old story, but the recent dry years have made forage so scarce that pack animals cannot be fed during the greater part of the year and hence ore cannot be moved from the mine to the smelter or to the railway connecting with the smelter. Wages in Chile are 50 to 100% higher than five years ago and the poor Chilean mining operator, working entirely by hand on a small scale, paying comparatively high prices for labour and for all supplies—even the *frutas del pais* —finds that ores containing 5 to 6% copper do not bring him a profit except under the most advantageous circumstances as to easy mining and cheap freight. The production of copper for the Republic for the year 1909 is reported at 36,360 metric tons, a decrease of 2568 tons as compared to 1908. A further fall in the price of the metal will seriously affect production.

MELBOURNE.

Politics. — The people of Australia are sharply divided into two camps. On the one side are the Unionists, or Fusionists as they are called on this side of the Equator; on the other is the Labour party and its allies. Labour under perfect discipline has swept the Australian political platform and now has the opportunity to translate idealism into realism. One of their objectives unquestionably is the nationalization of the coal mines of Australia. They want to do the same thing with the iron industry and with the Broken Hill silver-lead mining industry. So the course of Federal politics in Australia deserves to be watched by the investor. He has to make up his mind first as to what may happen to the Commonwealth should there be a State bank and State legal tender with the possibility of export duties on such articles as zinc concentrate. Next he has to try and estimate if in the domain of State politics Labour will sweep the board equally clean. On this point there is doubt. It will all depend on the moderation of the Federal Labourites. If that party tries to 'boss' the States and cuts their finances, then the voters in the States where Labour is not dominant may swerve from an alliance formed to get rid of coalitions and dead-beats. Any movement of that kind will build up the anti-labour vote in the State legislatures.

Tin in Tasmania.—The development of the deposits at North Dundas, Tasmania, is proceeding slowly despite the fact that the district has a good many possibilities. Its drawbacks are lack of capital and lack of mill facilities. For 18 years the prospector has been at work in the district doing well when tin was high in price and seeking other fields of employment when the market was adverse. A few believers in the district have stuck to it throughout and there seems to be some chance of a larger output. The country resembles in many respects the Mount Bischoff district, there being high outcrops of porphyry with altered slates that carry tin. In some cases the ore is associated with pyrite. This, of course, means roasting. At the higher elevations the detrital matter and the talus material contain tin. The most important formation is the Dreadnought Federal lode. This is an extensive fracture system from 30 to 70 ft. wide. Along the cross-fractures of the disturbed area extensive tin-bearing deposits exist carrying from 1 to 2 per cent of tin. These indications have attracted the attention of capitalists so that before long it should be known whether the district really deserves attention on a large scale.

Deep Leads.—Bewick, Moreing & Co. have decided to close down the Berry United mine at Allandale. This mine was opened up by them, with the hope that from it the firm would at last be able to make some return to the English shareholders who had sunk so much capital in the Victorian deep leads. Unfortunately the wash has not come up to expectations. The losses of English capital in Victorian deep-lead mining have been exceedingly heavy. It has been a uniform failure, whether on the Ascot, Cathcart, Berry, or Majorca systems. The failure is due to natural causes. It was predicted that the ground at Moorlort could never be unwatered. But powerful machinery settled this point. When the leads were entered it was found that the gold was distributed over so wide a channel of wash as to be unprofitable. Had it been concentrated in half the width of gutter then splendid returns might have ensued. Instead, disaster has followed. Of course, the mines had to be kept dry and the cost of pumping has been a serious item. In no case have the companies had the satisfaction of getting a dividend.

Charters Towers.—During the last fortnight in March £30,000 was paid in dividends at Charters Towers and to date about £6,000,000 has been returned to shareholders as the result of their investment in this district. Much prospecting work is being done by the various deep-level companies. On the Day Dawn lode in the eastern workings of the Brilliant mine at 212 ft. from the boundary profitable ore is occasionally found but so far unfortunately without developing a defined lode. On the Brilliant Block a formation has been cut at 1661 ft. and 3 to 10 inches of ore has been exposed. The company will in all probability sink its shaft to the main Day Dawn reef. At the Brilliant & St. George work is going ahead fast in promising country. The Mills Day Dawn and the New Brilliant Freehold are both doing well in depth, the first named having paid a dividend of £15,000 and the second £7,500.

A portion of Victoria.

The Mount Lyell Mining & Railway Co. will present a favourable balance sheet for the half-year just ended. In the September term 4538 tons of blister copper were produced and there is no reason why the figures for the March term should not be quite as high. Indeed, the output of ore from both the North Lyell and the Mount Lyell mines has been above the average, a fact that should mean a slightly larger yield of blister copper. The developments on the bottom level of the North Lyell mine have augmented the reserve, as an orebody 196 ft. long and 36 ft. wide has already been proved with exceedingly satisfactory copper contents. It is computed that the ore mined at the North Lyell for the six months was 67,000 tons and at the Mount Lyell mine 120,000 tons. The general impression is that the new orebodies proved will more than compensate for the sulphide ore extracted, so that it is expected that the reserve will remain at fully 770,000 tons. This is most satisfactory, especially when it is remembered that not so long ago the company was thought to be going down hill. Not only has the ore reserve developed satisfactorily but the manufacture of superphosphates has proved profitable. The company now has branches in several other States and, as an advantageous arrangement has been made with the other makers of superphosphates, good prices are obtained. Therefore, as one of the directors stated the other day, there does not at the moment appear to be a fly in the Mount Lyell pot of ointment.

The gold yield of the Commonwealth for the first three months of the year shows a further decrease, due in the main to a further decline in the output from Western Australia. All of the eastern States have done fairly well, despite the general depression. The comparative returns are as follows:

	First Quarter of		
	1908	1909	1910
	Fine Oz.	Fine Oz.	Fine Oz.
Victoria	162,661	156,422	158,656
New South Wales	62,562	47,403	51,179
Queensland	93,145	92,722	101,234
Western Australia	410,639	382,395	355,862
South Australia	1,937	747	1,860
Tasmania	15,000	15,000	11,100
Total Commonwealth	745,914	694,689	679,891
New Zealand	124,252	109,702	106,136
Total	870,196	804,391	786,027

TORONTO.

Cobalt.—As was anticipated when cheap electric power was secured for Cobalt, the ore shipments have steadily increased. There were 17 mines on the shipping list for April, the total consignments amounting to 2794 tons, against 2601 tons in March and 2280 in February. Conditions generally show improvement. The annual report for 1909 of the Nipissing, which held the leading place among the April shippers with 628 tons, is a most encouraging showing. The production of silver was 4,646,876 oz. at a cost of 16·39 cents per ounce, leaving a net profit of $1,687,000. The ore reserves are estimated at 6,539,200 oz. silver in 10 veins, more than three times the reserve of a year ago. The known veins on the property number 132, the largest being No. 64, which at one place shows ore 30 in. wide. At the La Rose recent developments have been highly satisfactory. An ore-shoot has been opened up in No. 3 vein on the west side of the Hill shaft. The ore extends for 1000 ft. on the 75-ft. level and averages 3 in. in width, carrying 4000 oz. silver per ton. On the east side of the Hill shaft an exceptionally rich orebody, stated to be good from the 135-ft. level up, is being stoped for 145 ft. Some good strikes have been made on the Lawson property, where rich ore is being opened up on No. 2 vein at the 88 ft. level. The improvements in the prospects of the La Rose is causing a slight upward movement in the stock, latterly much depressed, and the talk of a merger embracing the Nipissing, the La Rose, and possibly the Kerr Lake and Crown Reserve, has been resumed. The Beaver resumed active mining operations in April, and has since shipped 30 tons of high-grade ore from the 200 and 250 ft. level. The Rochester has struck good ore at the 75-ft. level in a shaft being sunk on promising surface showings. The vein is about 6 in. wide. The Trethewey, in driving a cross-cut north from No. 2 shaft at the first level, recently cut a new 4 in. vein, running about 6000 oz. silver per ton. The quarterly report of the Temiskaming reports the profits for the three months ending April 30 at $96,684. The mine is yielding well; No. 2 vein at 400 ft. averages 8 in. and assays 4000 oz., No. 1 is in good ore at 350 ft. and No. 3 carries 6 in. of high-grade ore at 390 feet.

Porcupine.—Now that navigation has been resumed a big rush of prospectors and mining men to the Porcupine country has recommenced. The movement has been stimulated by the satisfactory results of the sampling of 30 tons of ore from the Hollinger property owned by the Timmins Bros. and associates. The returns from Ledoux & Co., New York, showed over $200 per ton. The ore came from a careful sampling of each shooting down to the 60-ft. level, where cross-cuts were made in two shafts 350 ft. apart. The result has inspired confidence in the district and has considerably increased the prices for which claims are held. There is great activity in development work on locations. On the North Vipond, recently acquired by the Porcupine Gold Mines Ltd., an ore-shoot has been stripped for 400 ft. The vein is 5 ft. wide with a high-grade streak 2 ft. wide showing native gold. Miners are also going in large numbers into the lower Lake Abitibi country, where placer gold is reported along the lake shore. A dozen parties are at work.

JOHANNESBURG.

Sand-Filling.—Following the example of the Eckstein group, the Consolidated Gold Fields has decided to adopt the method of hydraulic sand-filling in the case of the Simmer & Jack and the Robinson Deep. The first mine to "set the fashion" was the Robinson, which was followed by other companies of the Central Rand—the City & Suburban, Village Main Reef, and Village Deep. The chairman of the old Ferreira also referred to the investigations being made as to the applicability of sand-filling on that property, which has long suffered from caving and subsidence. A local paper recently published a sensational article on 'Prussic acid for miners,' in which the possible dangers of filling the workings with freshly leached sand from the cyanide works were described in an alarming way. It need hardly be stated that the chemical side of the question is being amply investigated both as regards the neutralization of the acid in the old tailing and the cyanide in the fresh.

Increasing Labour.—During April there was a gratifying increase in the supply of labour, the total number of natives employed on the gold, coal, and diamond mines of the Transvaal exceeding 200,000. On the gold mines alone, there were employed 183,814 natives—an increase of 23,000 over January. A number of Rand mines have felt the labour shortage so acutely during the last six months that the maintenance of this improvement should be speedily reflected in better yields and profits.

Tube-Mill Equipments.—It is interesting, in view of the tube-mill controversy in progress, to investigate the plants of the various groups and to see how far each control has "committed itself" to this type of auxiliary grinder. In April, the stamps and tube-mills working on each group were as follows:

	Stamps	Tube-mills
Rand Mines	1815	43
Other Eckstein mines	950	25
Consolidated Gold Fields	1330	30
Barnato	880	2
Farrar	820	17
Neumann	805	12
Albu	680	18
Robinson	600	14
Goerz	330	2
Anglo-French	220	—

To determine how far the tube-mill has been favoured by each group, it is necessary to refer only to new or lately enlarged plants. For the Eckstein and Consolidated Gold Fields mines, the average ratio is 5 tube-mills to 200 stamps, but these groups include some mines of a much higher ratio, as follows:

Control	Mine	Stamps	Tube-mills
Gold Fields	Luipaardsvlei	60	3
Eckstein	Village Deep	180	6
,,	Nourse Mines	160	5
,,	Durban Deep	100	3

In the Neumann group, we find 1 tube-mill per 40 stamps on the Knight Central and Consolidated Main Reef; in the Robinson group, 1 to 40 on the Langlaagte Estate; in the Albu group, 1 to 22 on the Van Ryn; in the Goerz group, 1 to 20 on the Geduld—which shares with the Luipaardsvlei Estate the claim of the highest ratio. This will shortly be beaten by the plant of the Benoni Consolidated (55 stamps and 4 tube-mills) adopted, but not now favoured, by the Anglo-French control.

The Far East Rand.—Two new areas in this locality are now to be attacked namely, the Modder Deep Levels and the Government Mining Areas Consolidated or 'State Mines.' These two mines adjoin, and are surrounded by the New Modderfontein, Brakpan, and Geduld properties. The plans of development on the two areas will provide an interesting contrast. It is announced that Barnato Bros. will put down four vertical 7-compartment shafts on the 2600 claims* comprising the State Mines. These shafts will serve areas roughly of equal size. Two are placed to cut the 'reef' at 2000 ft. and two at 3000 ft. The scheme is bold but satisfactory. It is bold for the reason that it may one day involve the company in a call for additional capital, which the provision of £1,400,000 has, in the popular idea, rendered a remote contingency. It must not be forgotten that the estimates for this great mining area and the market valuations are based on a fittingly big scale of operations. Two million tons a year is mentioned with assurance, but a treatment capacity of more than 1,000,000 tons cannot be considered for many years to come. In the Far East Rand, shaft-sinking and development work are comparatively cheap; nevertheless it is necessary to allow not less than £400,000 for organization and shaft-sinking. Equipment and treatment plant on the million-ton basis would cost every penny of £500,000, when all the subsidiary expenditures on haulage, quarters, compounds, offices, etc., are included. This would leave another £500,000 for the development of about two million tons of ore for the mill, or, about three million tons in the mine. The prospects

*A Transvaal reef claim contains 64,025 square feet.

are, therefore, that the Government Mining Areas will be able to start milling in five years with a plant of 1,000,000 tons per annum and with a comfortable balance of working capital, which is a conveniently indefinite expression, conveying the idea that there should be ample funds to provide for emergencies, but inadequate for any policy of greater expansion.

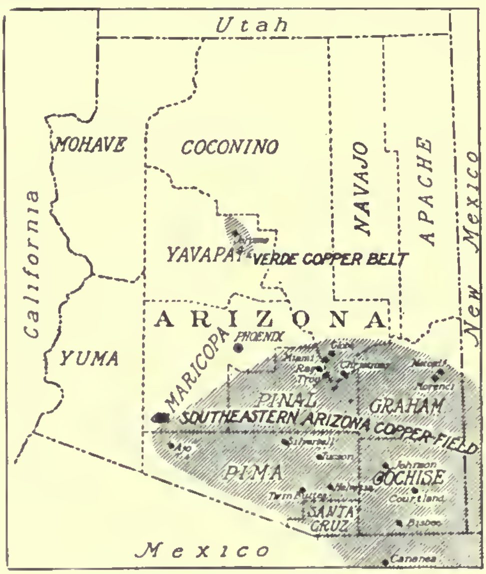
Modder Deep Levels.—Compared with the Government Mining Areas, the Modder Deep is a small property. With 377 claims, however, there is ample room for a prosperous mine if the prospects are fulfilled. In order to satisfy the Government regulations, two shafts must be connected before any great number of men can be employed underground. Instead of sinking two shafts far apart, thus giving the area two separate centres of development in accordance with common practice, twin shafts, each having three compartments, are to be put down 100 ft. apart. They will be connected for ventilation purposes every 600 or 700 ft. This practice will be new to the Rand. Having had occasion previously to reprove Tom Johnson in these columns for his impracticable ideas on the control of mines, as expressed before our local technical society, a good opportunity now arises for giving him credit for a sound idea by quoting from a paper delivered in March 1908, in which the advantages of twin shafts were propounded. He stated: "If on any property two shafts had to be sunk, they should be put down as close together as the law will allow, a connection being made between them every few hundred feet for ventilation; if water was met with, the temporary pumps could be placed in these connecting levels; afterwards permanent pumps would be necessary in one shaft only, but could be reached from both shafts. This would be much easier and cheaper than putting pumps in both shafts, as has been required at many mines. Having the two shafts close together and the drifts rising outwards from one point, all the water above the head of the inclines would drain to this point and the whole of the rock would also come to it. If an accident happened at one shaft, the other shaft would be available for the whole of the rock. At present we generally have a rise of a few feet between the two shafts making it very hard to get all the rock to one shaft if anything happens to the other. Another advantage of sinking the two shafts close together is that, being connected quickly, the development could be done cheaper, as the mine would be cooler and more comfortable to work in. It might be said hat development would be restricted, as there would only be practically one shaft to commence from, but I do not think this would be much felt in practice, as during the time the shaft boxes and stations were being cut, the main cross-cuts could be driven to where the head of both inclines, if two were necessary, would be, and the two inclines would soon diverge, thus providing room for development." Mr. Johnson makes out a fair case, but he certainly under-estimates the great value, in the large mining areas of today, of two centres of development 3000 to 4000 ft. apart, and the incalculable importance of the evidence that may be provided thereby on the scale of treatment operations suited to the resources of the mine.

The Marriott Scheme.—In technical circles, and often outside them, the introduction of the Marriott scheme of mining returns on the square fathom basis has continued to be a subject of keen discussion. The paper to be read by W. W. Mein on this subject (postponed on account of the King's death) has been anticipated keenly as a possible basis for a many-sided discussion. According to report, Mr. Mein is opposed to the employment of the 'square fathom stoped' as a unit for publication, but whether he advocates the retention of the 'ton milled,' or the use of the 'ounce of gold produced' as an auxiliary unit remains to be seen. Although the question of the unit *par excellence* appears superficially to be almost a popular one, merely because every shareholder talks glibly of profits and costs per ton, the influence of the unit and its fitting application to the various departments to provide a true criterion of changing efficiencies, are questions not only of a highly technical character, but, in their application to the Rand, necessitate a close knowledge of local conditions for their thorough application. This circumstance doubtless largely accounts for the exceptionally bitter feelings with which the innovation has been received, for Mr. Marriott is regarded as a 'stranger' so far as modern Rand mining practice is concerned. The excessive expressions of ridicule with which many mine managers privately discuss the scheme are to be greatly deplored. Even supposing the unit suggested to be utterly inapplicable, and meaningless in the majority of its usages and being no more "absolute" than the ton, and even though Mr. Marriott may have made unpardonable blunders in advancing the scheme, much good would inevitably result from a sober and scientific discussion of the question of wholesale mining and possible 'low cost per ton' abuses.

SAN FRANCISCO.

Copper.—Conditions continue unsatisfactory, and no important curtailment of output is noted. In fact, curtailment is not easy. It costs money to store metal and to carry interest charges on a surplus, and it costs money to shut down. Evidently opinion still favours storage of an accumulating excess of stock. The demand for steel and iron is good, and in the past a fairly constant ratio was observed between the consumption of iron and copper. This seems no longer to hold true. The output of iron and steel appears to be used in a considerable degree for repairs and renewals; it does not indicate a large growth of new business. This may account for the discrepancy above mentioned. The great banking firms are credited with giving the impression that the next three or four years will constitute another era of prosperity. The psychologic influence of such predictions is excellent; it is the Christian science of business; scientifically it is the making of good times by 'suggestion,' which is possible within certain limits. Hard times undoubtedly become harder because of the state of the public mind. But at bottom there exists a disproportion between the agricultural output and the demand, and that has unsettled business. The mineral output has increased proportionally with the growth of population, and so has manufacturing, but agriculture has not kept pace. Thus the phenomenon of high commodity-prices is witnessed alongside low metal-prices. Incidentally this fact should silence those who prate of the present high cost of living being due to the extraordinary increase in the output of gold. Were that the cause of the present disjointed state of business, all articles of commerce should mount in price proportionally. The truth is that such increase as there is can be explained by the higher wage-cost due to the greater cost of food-stuffs. The monthly statement of the Copper Producers' Association is regarded by many as a disturbing factor. At all events it has not been accompanied by growing consumption and better prices. Had it been so accompanied the copper miners would have pointed to it with pride saying: "Witness the value of virtuous publicity." Now they are saying that the public gets too much information, and there is talk of dropping the curtain and leaving the copper situation in mystery. The Copper Producers' statement has really never been explicit enough. One of the heaviest producers, whose word may be taken as truthful, declares that it is beyond the power of the Association to trace the consumption of copper far enough effectively to forecast either present uses or future needs. Nevertheless the analysis could be extended considerably, and it would create greater confidence and stimulate a healthier tone. To discontinue the monthly statement might arouse suspicions of trickery, which would be reflected in the value of shares. Perhaps this would serve some of the larger corporations a useful purpose in re-adjusting the balance of power.

Arizona.—Attention is now being directed more than ever to the Southwest. Criticisms have been made against the Superior & Pittsburg and the Calumet & Arizona, which mines are operated under the same management. They constitute an extension of the workings of the famous Copper Queen at Bisbee. It is



The copper region of Arizona.

true that the Superior & Pittsburg failed to earn a profit during the past year. The developments of good sulphide ore at depth, however, would indicate prosperity, even at 12½-cent copper. Criticism of the management might properly be suspended for a year. These properties are shipping over 1800 tons of ore daily to their smelter at Douglas. The Copper Queen is shipping 2400 tons per diem to the Copper Queen smelter at the same point. At both works extensive testing has been in progress for the saving of flue-dust. It is apparent that the losses are considerable.

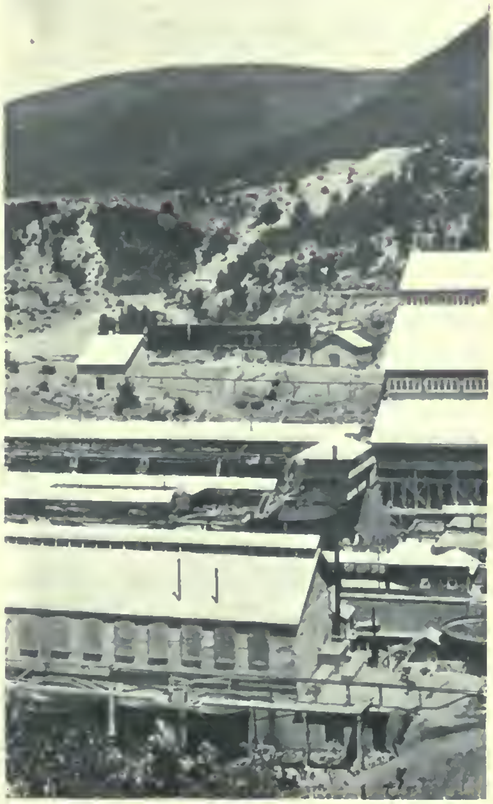
Flue-dust.—The Copper Queen has conducted the most elaborate series of tests on settlement of solids from gases at various temperatures and velocities ever undertaken. The data are now being collated for publication, the policy of James Douglas, president of the company, being always for publicity and the free contribution to the world of the new knowledge acquired in the operations under his charge. At the Calumet & Arizona smelter a novel device is being installed to settle the flue-dust. It is difficult to explain without the aid of drawings, but in principle it consists in concentric cylinders, of unequal length, the shorter being the inner cylinder. This is connected to the flue leading to the stack. The outer cylinder, closed at top around the other, terminates downward in a dust-box or bin; and on the upper inner wall it has projecting vanes to arrest the velocity of the gases. The intake is tangential to the outer cylinder near its top. Thus the incoming gases are given a rotary motion, the vanes produce friction, check the velocity and aid settlement of dust, and the gases then change direction, ascending through the inner cylinder the area of cross-section of which exceeds the area of the intake. Thus the gases should drop more of their load of dust at the point where they change direction. The apparatus will soon be installed.

Oil in California.—The development is proceeding with enormous rapidity, but in spite of this the production was 600,000 bbl. short of the consumption in the month of April. The famous Lakeview gusher, in the Midway field, belonging to the Union Oil Co., has at last been capped, after making a production in less than 60 days valued at $1,300,000. Great excitement has been occasioned by the introduction into Congress of a bill, known as the Pickett bill, providing for the separation of oil, gas, coal, and phosphate lands from other mineral lands as regards their location for purposes of obtaining title. The plan of the conservationists is to lease such lands instead of giving title to them, and it is proposed in the case of oil to levy 15% royalty. There is, however, a difference between conservation of natural resources, and legislation bearing the conservationists' hall-mark. The situation is complicated by the circumstance that the transcontinental railroad corporations own every alternate section of land through large areas in the West, extending 10 miles back from the railways, and in places even 30 miles. It happens that these lands cover a large part of the oilfields of California. So it makes little difference to the railroads which conservative process is applied to the Government lands, whether restrictions be made by withdrawal from entry or by a heavy royalty. The railroad lands are patented and the patents carry the right to the minerals. Hence inducements can be offered to operators to acquire railroad lands in preference to the others, and the withdrawal from entry necessarily leaves free the alternate sections which the railroad corporations were shrewd enough to patent before the conservationists' outcry had grown dangerous. It is interesting to see that the very weapon that the conservationists hoped to wield against the corporations is likely to become an instrument for their advantage, so far as the oil business is concerned. A great protest has been made, and W. W. Orcutt, geologist of the Union Oil Co., and Ralph Arnold, the representative of other large interests, together with a delegation of operators, have gone to Washington to protest against the passage of the bill in its present form. It is said that a powerful combination has been made among the independent oil-producers by the signing of an agreement between the American Petroleum, the Nevada Petroleum, the American Oilfields, and the companies controlled by John Barneson of San Francisco. The object of the coalition is thought to be the prevention of destructive competition, and also the furtherance of the project of a pipe-line from the California oilfields to the centres of consumption in the mining districts of that Territory and of Sonora, Mexico.

MEXICO.

Railroad Building.—Some of the Mexican states now guarantee interest on capital invested in railroads to open new territory. The State of Zacatecas has agreed to a guarantee of 5% on mortgage bonds to be issued to provide funds for the building of a road from Camacho, on the El Paso-Mexico City line of the National system, across the State to the Mazapil mining district. The Madero interests of Monterey and Torreon, controlling the Torreon custom smelter, have the concession, and the financing will be done by the Franco-Español Bank. The Mazapil Copper Co., an English concern, is the principal operator in the Mazapil district, and operates a railroad from Concepcion del Oro, in that district, to Saltillo, the capital of Coahuila. The company has a copper smelter at Concepcion del Oro and a lead smelter at Saltillo. The new railroad will extend direct to Mazapil, with a branch to the Bonanza camp, where the American Smelters Securities Co. is heavily interested, and open up much mineral territory. Recently the Durango government granted a concession for a railroad into the Guanaceví mining district, and agreed to a guarantee of 6% on the money invested for 25 years. The line is projected to extend from Tepehuanes, the terminus of the International railroad.

Dos Estrellas.—At the recent general meeting of the company operating this big mine in the Tlalpujahua district of Michoacan, adjoining El Oro, it was shown that the profit of 1909 amounted to 3,786,541 pesos, or 1,205,000 pesos in excess of that earned in 1908. Dividends of 3,000,000 pesos were paid. Early this year the dividend rate was increased from 2·50 to 3



El Cedro mill, of the Dos Estrellas.

pesos per share quarterly, and the first quarterly disbursement was 900,000 pesos, there being 300,000 shares. This rate will remain in effect through the year, and the 1910 dividends will consequently amount to 3,600,000 pesos. The ore extracted in 1909 amounted to 348,580 tons, and the average cost of extraction was 7·09 pesos per ton of ore. The average milling cost was 3·04 pesos. The general manager reported that at the end of the year the ore reserve was estimated at 2,018,000 tons, and that in addition there was a reserve of 2,843,000 tons, which under present conditions cannot be treated profitably. The Dos Estrellas will soon have in operation the second largest vacuum-filter plant in the world. It is of the Butters type and has a capacity of 1000 tons.

Santa Gertrudis.—This subsidiary of the Camp Bird company in the Pachuca district of Hidalgo is making good progress in the erection of a cyanide plant adjacent to the San Francisco shaft. The plant will be of the most modern construction, and will handle about 15,000 tons of ore monthly. It is hoped to have it ready for operation in October. The cyanide plant built by the old Santa Gertrudis company during the time that the Camp Bird option was in effect, and for which the Camp Bird paid 344,825 pesos, is at the old Guadalupe hacienda, several kilometres from the mines. This plant may not be operated after the new plant is completed. It is interesting to recall that R. J. Frecheville, one of three engineers who examined the Santa Gertrudis mines for the Camp Bird, and who placed a value of £924,000 on the ore reserve, estimated that there should be a profit of 20 pesos per ton on 160,000 tons of ore annually, or a total annual profit of 3,200,000 pesos.

Mining Law and Prospecting.—There has been some criticism of the new mining law of Mexico on the ground that the provisions governing the acquisition and working of mining claims restrict prospecting to such an extent as to interfere with the opening of virgin mineral ground. The law provides that no exploratory work shall be done on unclaimed land without an exploration concession, and that when a denouncement is made the ground denounced shall not be worked until title is issued by the Government. There are penalties of fine and imprisonment for violations of the provisions. When unclaimed mineral ground is under private ownership, bonds to cover any possible damage to the owner are requisite in obtaining exploration concessions. All concessions are limited to 60 days. When a denouncement is made a deposit of 5 pesos per *pertinencia* is required, and the expenses of publication, surveys, monuments, etc., must be liquidated before any attempt is made to determine the worth of the claim. It is believed that these restrictions will deter many prospectors. Modification of the provisions may be asked.

Yaqui River Region.—The 60-ton cyanide plant of the Barranca Mines, of London, at Las Goteras is nearing completion and will be soon in commission. It is stated that the ore reserves are sufficient to keep the plant in steady operation for two years, and that it is planned to keep the supply of ore far ahead of the mill consumption. At the neighbouring coalfields of the Southern Pacific 150 men are at work getting out coal and natural coke. Coal from these fields will be supplied to the Barranca mines. Experiments with the natural coke will be made at the custom smelter of the Yaqui River Smelting & Refining Co., at Toledo, now ready to go into commission. The successful operation of this smelter, which was built several years ago, has been made possible by the completion of the Yaqui river extension of the Southern Pacific to Tonichi. The capacity is 180 tons daily. The Torres & Prietas mineral railroad, extending from Torres, on the Sonora railway (Southern Pacific), to Represo, 27 kilometres, has been sold by Mrs. Myra Seymour, widow of Col. Frederick H. Seymour, of the British army, to the Mexican Union Railway Co., of London, and it is now planned to extend it to a connection with the Yaqui river line of the Southern Pacific. Important mineral territory will be opened. Surveys are being made for a railroad projected to extend from Tonichi, on the Yaqui river line, across the Sahuaripa district of Sonora to the properties of the Cieneguita Copper Co. and beyond. The financing is in the hands of a syndicate headed by Charles Deering, of the International Harvester Company.

CAMBORNE

Parbola.—This mine has been intermittently worked for hundreds of years. At intervals a syndicate or company makes an attempt to work the mine, and the engineers are usually careful not to lose much money. The shaft has been sunk on an elvan by the present owners 8 fathoms below the 40 fm. level. This elvan or dike was soft for a depth of 20 fm., as may still be seen by the surface workings. Below 20 fm. the elvan became a little harder. The tin is found in minute seams at right angles to the elvan, which is from 40 to 50 ft. wide and has a strike of approximately east and west. In former workings these seams were no thicker than a knife blade, but they are now getting larger, and massive tin is occasionally found, favouring the theory that with depth the seams will unite. This mine in former times has been largely, if not entirely, worked by tributors, consequently development was at zero. It would be a wise policy to cross-cut to the north at the 40 fm. level, as the seams of tin extend beyond the elvan in the clay-slate formation for a distance of 15 ft., though not in paying quality as yet, whereas on the south, not a trace of tin can be found beyond the south wall of the elvan. A cross-cut has been extended south 400 ft., at the 20 fm. level, without finding any ore. On the north several well known lodes have been worked. At surface all the plant is in good order. The shaft is kept dry by means of a 12 in. Cornish pump driven four strokes per minute, with a coal consumption of 1½ tons in 24 hours, as against 5 tons formerly required to work the electric pump. The equipment consists of 20 Californian stamps, Wilfley tables, Frue vanners, a Record table, and two Acme tables. A scheme is now on foot to work this mine in conjunction with adjoining setts at present inactive, including Rosewarne Consols.

East Pool & Agar.—Marking time is the order of the day, and the shareholders will eventually have to pay heavily for the committee's delay in either pushing the proposed conversion of the present company into one of limited liability as mentioned in last month's notes, or producing an alternative scheme to raise the necessary capital. The losses must be heavy as only 41 tons of black tin per month are now being sold, and thus good money is being frittered away in losses which might well have been spent in much needed development. The discovery of the long lost Great Lode in Wheal Agar seems likely to prove an important one. This lode has been the main producer in East Pool and Agar, and it is on its scrapings that the company has been living for years past.

Carn Brea & Tincroft.—Judging from the latest progress report issued by this company, the mines generally are looking a little better. At Martin's east, a winze below the 140-fm. level is valued at 152 lbs. per ton; 39 tons have averaged 71 lb. per ton. At Downright, the drift on the South Lode between the 320 and 335-fm. levels is producing an average of 65 lbs. of black tin per ton. At Highburrow East, the development points are producing an average of 31 lbs., and this is an improvement of 4 lbs. on the produce from this section of the mine last year. It is reported that an important discovery has been made in this part of the mine at the 155 fm. level east, the lode being 6 ft. wide and averaging 90 lb. per ton. The question of magnetic separation is again being considered, and recently some tests were made at East Pool on Carn Brea ores. Further tests are to be undertaken on a large scale.

In the Fowey valley, nine miles north of Liskeard, the Marsh syndicate are testing their ground with a Banka drill. They control about 500 acres. Almost the entire area was worked 50 years ago; it is assumed that the bed-rock was not reached at that time. So far 46 holes averaging 13 ft. 10 in. deep have been put down and the results obtained indicate that the wash averages about 8d. per yard, with tin at £140. The drilling operations are under the capable management of F. W. Linck. Should these satisfactory results be maintained over the entire area a dredge will be installed. Mr. Linck estimates the actual cost of drilling at 16·77 pence per foot, including foreman and washer, but undoubtedly this cost would be much less if the holes were deeper and the shifting of the machine less frequent.

Over the hill the Colliford Mines Ltd. has stopped its washing plant, and under the superintendence of C. O. Spear is now testing the

Banka drill in operation in the Fowey Valley.

ground to determine its adaptability for dredging. The test is being made by sinking pits —a method of prospecting which seems slow and expensive after watching the operations of the Banka drill.

Wheal Hampton.—A good deal of work has been done by the St. Stephen's Syndicate on this property at Marazion during the past twelve months, and the results are encouraging. After unwatering the mine to the 30-fm. level, a plunger-pole lift was supplied in place of the drawing lift in the main shaft, preparatory to sinking a further 12-fm. A new air shaft is being sunk to the 30-fm. level to ventilate the bottom workings, and to prove the eastern ground. This shaft intersected the lode at 8-fm. from surface, and has since been carried down on the underlie. The adit level and 20-fm. level have been connected. According to official information, the lode averages 6 ft. wide, and assays 40 lbs. of black tin per ton in the upper levels, increasing in value to over 82 lbs. per ton at the bottom. Twenty Californian stamps were erected by previous owners, and the dressing plant, capable of dealing with the output from half the battery consists of 1 Record vanner, 2 Buss tables, 2 Luhrig vanners, and a tube-mill, together with the necessary slime plant. The headgear from Wheal Commerce has been purchased for erection at the main shaft. During May $6\frac{1}{2}$ tons of black tin was sold realizing £555.

West Kitty.—A start has been made to drain the bottom levels of the Wheal Friendly section of this property, and new pumps are being put in to recover the lift lost in the accident early in the year. No attempt is apparently to be made to drain the Reynolds's and Thomas's sections until the big electrical pumping station of the St. Agnes Consolidated Company has been erected, the site for which, it is rumoured, is to be on the old Royal Polberro mine just above the harbour. This is an excellent position, and supplies could be cheaply brought in by water as was the case before the railway was built. The stopes at Wheal Friendly have, judging by the sales, fallen off recently. Ninety men have been discharged, so presumably stoping has practically ceased.

Wheal Vor.—The unfortunate accident to the engine at this mine referred to in our March notes has proved more serious than was at first anticipated, and the water is now up to the adit again.

Condurrow United.—Capt. Joseph Tamblyn, who has been consulting engineer to this company for some time past, is now permanently in charge in place of Capt. S. Bennetts. The funds provided by the recent reconstruction scheme will no doubt soon be available, so it may be expected that the property will be drained to the bottom, and vigorously developed eastward towards the great cross-course. It is to be hoped that chokages such as that in the shaft at the 205 fathoms level, will not occur below that depth, otherwise the management will not, with the resources at its command, have sufficient funds to adequately explore the eastern ground. Local people are nearly unanimous in thinking that a mistake was made in the first instance in attempting to clear Neame's shaft, and certainly as events have turned out, it would have been better to sink a new shaft in the heart of the ground now to be proved.

METAL MARKETS

COPPER.

Average prices of cash standard copper :

May 1910.	April 1910.	May 1909.
£56. 6s. 11¼d.	£57. 5s. 0d.	£59. 9s. 8¼d.

The movements in the market have been less marked during the last month than for some time past. Stagnation ruled during the depression following the death of the late King and we have had none of the acute drops and subsequent rallies which have been the feature of this market for so long. The protracted liquidation by holders of copper warrants appears at last to have run its course. The public seems tired of speculating in a market where they have never had a chance for months of securing a profit as bulls. Consumption has again been large and demand is still unsatisfied. The present low level of prices appears attractive to the consuming industries. In Europe, German and English manufacturers have been buying actively. Good orders for locomotive plates and tubes and for shipbuilding and engineering trades have been received. The electric trade and even sulphate of copper makers have experienced a smart demand. Large lines of raw copper mostly electrolytic have been placed at advancing prices. In America the position has not been quite so strong. No evidence has been forthcoming of the large lines reported as being sold by producers, but consumers there must be badly supplied. Attempts to purchase from producers have been unsuccessful owing to the firm attitude of the latter. The panicky conditions in America and the weakness in Wall Street following the Government's action in restraining the Western lines from increasing freight rates has had little influence in the price of copper. The growth of consumption must be considered satisfactory, but in spite of the enormous demand supplies are super-abundant. It is difficult to see any chance of an appreciation in price except either by an agreement among producers to curtail the output or in a still further growth of consumption. The increase of 8000 tons in American stocks at the end of April was more favourable than was generally anticipated ; but the further increase of 8000 tons for May is a disappointment. The European stocks in warehouse show a steady decline and are now only 98,915 tons. The decrease in the month of the total European visible supply amounts to 3392 tons.

TIN.

Average prices of cash tin :

May 1910.	April 1910.	May 1909.
£150. 1s. 8d.	£149. 19s. 3d.	£131. 16s. 10d.

Prices have been steady with a strong undertone. The April figures, showing a decrease in the total visible supplies of 2444 tons, were unexpected and induced a better consumptive demand which increased in strength as the month advanced. The East came out as sellers towards the middle of the month, on a fall in the 3 months price to £150. 10s. American enquiries became somewhat urgent and called for shipment from London warehouses. Bear covering ensued and caused a smart rally to £152. 5s. Eastern shipments for the first fortnight of May, estimated at about 3000 tons, a somewhat large figure, were at first ignored, but finally caused importers to meet the persistent demand of consumers and of the speculators who were following them, and towards the end prices weakened.

LEAD.

Average prices of soft foreign lead :

May 1910.	April 1910.	May 1909.
£12. 11s. 8¾d.	£12. 13s. 9d.	£13. 5s. 3·37d.

Lead suffered early in the month from persistent and heavy realizations by speculative holders combined with bear selling, and prices declined somewhat severely. At the lower level however consumers who had hitherto held off purchased freely and prices have since shown a rising tendency. The upward movement has not been carried far, values showing about 7s. 6d. rise from the lowest level. The steadying effect of the agreement among producers has shown itself in the absence of excitement during the recent buying movement.

SPELTER.

Average prices of spelter :

May 1910.	April 1910.	May 1909.
£22. 1s. 1½d.	£22. 9s. 10d.	£21. 19s. 0·37d.

Until the end of the month when some spirited bidding for early delivery in London roused the market, this metal remained idle and uninteresting. The demand for galvanized sheets is dead and shows no signs of a revival. On the other hand the trade has allowed stocks to run down to a level at which a buying movement cannot be long deferred.

DISCUSSION

Our readers are invited to criticize anything appearing in this magazine and to discuss other subjects of general technical interest.

Dredging for Gold.

The Editor:

Sir—In your issue of February, Mr. C. W. Purington takes the trouble to criticize the article on gold dredging written by me in the *Mining Journal* of November 20. Mr. Purington does not attempt to combat my figures, but says: "I do not think that Mr. Cutten has by any means shown in a convincing way that a dredge of the New Zealand type is more likely to pay dividends than one of the Californian type."

My reply to this is that there are very many more of the New Zealand type of dredges which are actually paying dividends than there are of the American type doing so. There are a large number of companies paying dividends both in Australia and New Zealand with New Zealand type of dredges. There are also companies paying dividends with New Zealand type dredges in the following countries, namely, Burma, Russia, British Guiana, and the Philippines, while I do not think that Mr. Purington can mention any instances where an American type of dredge is paying dividends outside of the American continent.

To give all the information requested by Mr. Purington would require the writing of a treatise on dredging, so I shall only attempt to answer some of his points, as arranged by him alphabetically.

(A) "Enumerate the component factors of the cost of dredging, according to his understanding."

This sentence is vaguely put and a reply is, therefore, difficult. To my understanding the component factors are labour, power (represented by fuel in steam-dredges), repairs, and administration. Under similar climatic conditions the New Zealand type can be run with much less labour than the American, for even when using steam, where a stoker is required, the New Zealand type proper does not require more than two men per shift, plus the dredge-master, no matter what size the dredge is, unless in tropical climates. In New Zealand where men are not afraid of work I have known of an electrically driven dredge run for many a shift with only one man on board, while the American type seems to require more than two men even when electrically driven. The cost of power depends upon the local conditions; if either cheap fuel or electricity is available the power account should be low, but in spite of the Oroville company's cheap electrical power (1·5 cents per k.w.h.) the power has cost that company in every instance much more per yard lifted than any of the New Zealand dredges mentioned by me, and curiously enough, according to the Oroville company's figures, the dredges with the smallest buckets have not by any means shown the highest electrical cost per yard. If this company had had to install its own plant for generating the electricity, the power account would have been much higher. Repairs on the American dredge, at Oroville, are a great deal higher than on the New Zealand type; in some extreme cases as much as nine times.

Administration costs depend to a great extent on climatic conditions, and in some tropical countries they are very high. They should also depend upon the number of dredges operated, and although the Burma (tropical) costs, with three dredges, are lower, and the New Zealand costs, with one dredge for each company, are much lower than at Oroville, these figures should not be taken into consideration when comparing the efficiency of types of machines.

(B) "In each case cited give (so far as he is able) the capital expended in equipment, the yardage to be worked, and the approximate life of the property in years."

To this I might reply that the whole of the nominal capital in the four New Zealand companies mentioned in my article is £33,949, the total amount expended in equipment was under £28,000, and the dividends paid during the first 7 years amounted to over £151,500, equal to over 4½ times the whole capital of the four companies. Three of these dredging companies have now been working for over 9, and the fourth for 11 years, and they are still paying dividends. I could quote quite a number of dredging companies in New Zealand that have done and are doing quite as well, if not better, such as the Electric, the Golden Treasure, the Dunedin, the Golden Run, the Ngapara, the Magnetic, the Enterprise, the Earnscleugh, and the Notown; but, as I said before, there is a difficulty in obtaining detailed figures from New Zealand companies. It may, however, interest your readers to know that in the New Zealand Government mining returns there are 25 dredging companies mentioned, mostly with one dredge each. These companies have a total nominal capital of £226,062, of which £140,704 has been paid up, and they have paid £620,081 between them in dividends up to the end of 1907.

None of the Californian dredges, in spite of their excessive cost, can show figures like these, certainly the Oroville cannot. As far as I can judge from the reports, that company has a capital not far short of three-quarters of a million sterling; it has, I believe, paid some six dividends at the rate of 10% each, and now is securing fresh concessions in Colombia as the ground at Oroville is approaching exhaustion. The Burma Dredging Co. has a nominal capital of £120,000, it has expended about £95,000 in equipment, is paying dividends, and has workable ground sufficient to last for 40 years with the present number of dredges.

An American dredge, built in the United States, was put to work in Tierra del Fuego about four years ago. It cost about £16,000, burned 7 tons of Welsh coal per day, employed about five men per shift, and, after struggling for two seasons, it shut down as it could not pay its working expenses. An English dredge was put on the same flat, about a stone's throw from the American machine. With steel pontoons, at work on the claim, it cost under £12,000; it consumed two tons of coal per day, ran with two men per shift, plus a dredge-master, obtained £7200 worth of gold in the first 4 months, and is working now, while the American dredge is abandoned. A third instance might be given where an American-built dredge was sent out to the Philippines and failed to pay its way; it was then shifted to another property, where it has also failed to pay. In contrast with this, two dredges were sent from New Zealand and put to work on the Paracale Co.'s claim, which I understand is quite close to where the American dredge was working, and these two New Zealand dredges have done so well that 6 more machines have been ordered. So much for capital expended on equipment and approximate life of properties.

(C) In answer to this query, the average gravel dredged in New Zealand is much rougher than any I saw in the Oroville, Folsom, or Yuba districts. On the Yuba the gravel, though comparatively small, was tightly cemented in some instances, but No. 4 dredge was working particularly easy ground. Three of the New Zealand dredges that I have mentioned were working in rough ground with many boulders and buried timber, one of them was working on a hard uneven schist bottom, the fourth was working easy ground. For a description of the Burma Co.'s ground I shall quote the managing director's own words used in conversation with me during the present month. After reading your editorial in which you describe the Burma ground as "loose gravel affording easy digging," he said: "On parts of our claim I have seen 11 consecutive buckets go up the ladder and on each of these 11 buckets there was a stone of from 600 to 1200lb. weight."

Mr. Purington quotes from a letter to him by a man whom he styles as "one of the most successful dredge-operators I know." This man says: "Sometimes we dig in limestone bedrock for a month at a time, going into it several feet in depth." The same operator says: "In the three-and-a-half seasons that we have been running the dredge, the longest single stop, except for clean-ups, has been 1 hour and 40 minutes, with an average running time for the entire period exceeding 23 hours out of every 24, while 18 hours running time out of every 24 hours is about the average record for modern dredges to run while operating in ordinary ground. Considerably more than half our lost time is caused from delays to the steam part of our machinery."

Personally, I should think twice before quoting such figures, claiming that a dredge working under frozen or "hard conditions," digging several feet into limestone rock, can average 23 hours work per day for three years in succession, when Californian dredges of similar design and construction can only average 18 hours per day for the one season in easy ground, or in other words this Klondike dredge with more than half its stoppages due to engine troubles would, if electrically driven, run in frozen ground with considerably less than half an hour stoppage per day, when similar dredges working under easy conditions lose 6 hours per day.

The statements of this successful operator should be taken with about the same seriousness as those made by a self-styled dredging expert to a friend of mine. He stated that "in the United States they have dredges which are lifting boulders of two tons weight, and grinding them to powder on board the dredge."

In reply to paragraph (D), I certainly should recommend a properly designed and constructed New Zealand type of dredge to work any class of ground, especially for rough and bouldery ground. I should put close-connected buckets on easy ground containing only small gravel. I cannot, however, recommend the abortion or so-called New Zealand type of dredge, often made by firms who have little or no experience on the subject, but have obtained plans of some obsolete New Zealand machine, improved on these according to their own lights, and expect the same machine to suit all classes of ground, or the ground to suit the machine.

From his letter it would appear that Mr. Purington assumes that I do not approve of large and heavy dredges. In this he is quite in error, for I certainly do approve of large and heavy machines in all ground where the quantity of gravel to be treated will warrant the expenditure. In his argument for heavy machines in easy ground Mr. Purington appears to overlook the fact that all machines should be designed to suit the ground which they are intended to work; therefore if a dredge designed to work heavy ground is put to work light ground the table-area will be insufficient for the greater quantity lifted.

My contention all through has been that the costly American dredge, with its excessive wear and tear, under equal conditions does not treat the gravel at such a low rate as the less costly New Zealand type, consequently the latter appears to be the better investment on the capital expended. Many of the English companies for which I have designed dredges have either had a limited area of ground or small capital to work upon, hence the restricted size of the machines, but the Burma company operates a 10-ft. bucket dredge, gas-driven. When this dredge has been at work for 12 months I hope to be able to compare its working results with those of the 13-ft. bucket American dredges, also with the American type now being built for Burma.

Mr. Purington takes me to task for quoting figures that appeared in a manufacturer's catalogue, and suggests that professional men will not be convinced by facts supplied by machinery dealers. Unfortunately for his contention, these figures for the same two dredges also appear in a book ('Gold Dredging in California') issued by the Californian State Mining Bureau, and such authority amply justifies their quotation.

In the *Mining Magazine* of March Mr. Purington goes on to describe some of the dredges working in Russia and compares them with the American type; he finds quite a number of faults, the first, which he considers the most important, being the fact that they are not electrically driven. I have already shown from the figures of actual work done in different parts of the world that steam-power is much cheaper than electricity even when purchased from a power-company at the low rate of 1½ cents per k.w.h., as at Oroville, and with no interest or sinking fund to be chargeable against the generating plant. I quite agree with Mr. Purington that the dredges at Neviansk are poor machines. They were recently described to me by the manager of the New Central Siberia Dredging Co. as "mere heaps of scrap iron." They are no more like the present up-to-date New Zealand type than the early American dredges are like those of the present day.

If Mr. Purington had wished to make a fair comparison, he might have referred to the two dredges of New Zealand type on the Demidoff Co.'s mines in the Ural. These two machines were designed and built in England about two years ago. They are steam-driven dredges with 7-ft. open-connected buckets and pan-stackers. They cost, with steel pontoons, and at work on their claims, £12,500 each. They have succeeded in working right through this last winter without any special heating or thawing equipment, a thing never before known in northern Russia. They are working in ground that contains a great deal of buried timber and they are described by one in authority as "magnificent machines" although I must admit that (like all other dredges) they have their faults. The latest record I have of these machines is that during the last 6½ months they have treated 661,500 cubic yards of gravel and won £59,068 worth of platinum or 1s. 9d. per yard. These dredges have worked so well that an order has been given to design a similar machine to work in Russia for a French company, notwithstanding the fact that 45% duty has now to be paid on it.

In your issue of April, W. H. Shockley mentions two dredges of the Bucyrus type and design, built in Russia, and he says that they are working profitably on the Ivdell river. The value of gold in the ground lifted by these dredges is given at 9·4 pence in the one case and 6·8 pence in the other, while the working expenses are estimated at £3000 per annum per dredge, and the profit is estimated at £4000 per annum for each dredge, but there is no suggestion of any dividend having been paid. In ground of the value of only 6·8 pence per yard there ought to be a considerable profit with a good machine, something nearer £12,000 a year. I can give an instance of a 5 cu. ft. New Zealand dredge working ground worth only 4·13 pence per yard and the profit for the year was £8000, £7500 of which was paid in dividends and £500 carried to reserve.

Mr. Shockley appears to have been misinformed about the two dredges working the platinum deposits at Nijni Tagil. These machines are the ones to which reference has been made as working on the Demidoff mines; they were designed by my firm and they are paying handsomely. Mr. Shockley also appears to be mistaken about a number of American dredges working at the Northern Taiga. George McGregor, late manager for the New Central Siberia Co., informs me that he has been all over the Northern Taiga dredging properties quite recently. He says that there is not an American type of dredge in this district, and with the exception of the Central Siberia Co.'s dredges, which are of the New Zealand type and built in England, they are all poor copies of obsolete New Zealand machines, and were built in Russia.

The figures for the two Ivdell machines quoted by Mr. Shockley are interesting, and I presume that these machines are steam-driven; if so, I fail to see how Mr. Purington can reconcile these figures with those of the electrically driven dredges, which he claims to be so superior to the steam-driven, for according to the Oroville Co.'s figures, with cheap electrical power, that company's 3-ft. bucket dredges cost £5700 per annum to run in the one case, and £6700 in the other, while their two 5-ft. dredges cost £9000 and £11,000, respectively, to run.

In the *Mining Journal* of April 23 there is a report that an American dredge is being built for the Orsk Goldfields, to the order of Mr. Purington, and this one dredge, which I understand is a 7½-ft. bucket one, is estimated to cost £50,000, when installed. Surely this is an excessive cost, and to my apparently biased judgment it would have been a better investment to have spent the £50,000 on three, or possibly four, 7-ft. machines, such as those that have done so well for the Demidoff Co. at Tagil. Three 7-ft. machines would certainly do more work than one 7½-ft. American or any other make.

W. H. CUTTEN.

London, April 28.

The Square Fathom.

The Editor:

Sir—The points that you make against the use of the 'square fathom' seem to me well taken. In discussing the matter the other day with a friend of mine, he said he doubted if a large proportion of men in countries other than British know what a fathom is. Why is any new unit necessary? Anyone who is capable of reading a mining report intelligently knows that he cannot compare the 'cost per ton' of one mine with those of another, unless he is familiar with the conditions of both. The inclusion of 'cost per ton mined' in cases where sorting is practised, gives more information than 'cost per square fathom' can, where one does not know the width mined. Have we not a right to expect something better than this from a prominent member of the council of the Institution of Mining and Metallurgy? The Institution not long ago sent out a circular in which it asked its members to use various standards, but nothing so antiquated and little known as a fathom was mentioned.

FRANCIS DRAKE.

San Francisco, May 2.

Oil in the Potter Process.

The Editor:

Sir—Your article in the March issue, on the 'New Potter Process,' carries me back to the time when I found myself appointed as pioneer manager of the Zinc Corporation, at Broken Hill, and engaged in an endeavour to worry out the governing principles of the original Potter process and the reason why, at times, excellent results were obtained, while, subsequently under apparently precisely similar conditions, on material of identical chemical composition, our operations would be anything but a commercial success. You rightly say that "no mention was made of oil in the specifications (the original Potter patent specifications) nor is it stated that any was actually used in the process," but you are inaccurate in saying that "as exhaust - steam was used for heating the solution, no doubt some oil was actually present."

The fact is that Potter had no need to mention it in his specifications, for I am absolutely certain he never once used it in his experiments and probably never even dreamt of applying it in the practical working of his process.

For years, the Broken Hill Proprietary Co. successfully ran a plant with a capacity of 1000 tons per day, without the use of either oil or exhaust-steam and during the lengthy periods when the Potter process was in operation, both on the Block 14 mine and in the experimental mill of the Zinc Corporation, neither oil nor exhaust-steam found even a tentative place.

I am well aware that the supporters of the various patent oil - flotation processes have made the assertion that the success of the Potter system depends entirely on the presence of small quantities of oil, but I am equally confident that even they, at least in their laboratory researches, must have demonstrated, over and over again, to their own satisfaction, that the flotation of the Broken Hill sulphides can be successfully accomplished in plain hot sulphuric acid, quite independently of the presence of oil in the most minute quantities.

It is years since A. de Bavay, a research chemist of the first water, and himself the patentee of the successful process bearing his name, demonstrated that the success of the Potter process was due, not to oil, but to the presence of a film of air around the naturally greasy-faced sulphide and to the formation of gelatinous silica, the result of a chemical reaction, in the hot sulphuric acid, between two of the constituents of Broken Hill ore, namely, fluorspar and quartz. This colloid silica performs practically the same function as the oil of other processes, smearing the air-enveloped sulphide particles and clotting them into flocculent masses that become buoyant under the combined agency of heat and the entanglement of the rising bubbles of carbonic acid, which is generated continuously by the action of the hot acid on the ever-present calcium carbonate.

Mr. de Bavay has further shown that if the Broken Hill material contained neither a soluble silicate, nor the combination of fluorspar and quartz, the buoyancy of the sulphide particles, although naturally greasy-faced and air-enveloped, would be so impaired as to render the Potter process impracticable, and that if the air films around the sulphide particles were absolutely destroyed, even the presence of added oil would fail to effect the selective action on the sulphides or produce any results with the semblance of success. In support of the gelatinous silica theory, I have invariably found that even the specially selected particles of sulphide obtained by the Potter process have a gelatinous coating, which, on drying, becomes altered to the crystalline form of silica, and from which they can easily be separated by the use of either mechanical concentrators or magnetic machines.

The addition of oil in the new modification of the Potter process appears to be a matter rather of financial than metallurgical importance at Broken Hill, eliminating the necessity for high temperatures and comparatively strong acid solutions, and rendering it possible to operate successfully under more reasonable and cheaper conditions in a country where fuel is an item of heavy expense.

The presence or absence of oil is certainly a subject of secondary consideration compared to, at least, one other matter, which, though of vital importance, is seldom even referred to, and which in the early stage of the Zinc Corporation was completely overlooked, namely, the absolute necessity for efficient aëration of the sulphide particles prior to their immersion in the hot acid. In the March article it is mentioned that, after crushing to the required fineness, the "ore is drained of its surplus water," but no stress is laid on the fact that, in that draining, the essential air is drawn into the intersticial spaces of the material to be treated and that on the thoroughness of that preliminary aëration, depends largely the extent of the final success. Prior to my arrival at Broken Hill, the preliminary crushing and subsequent treatment of the tailing by the Potter process had always been separate and independent operations, and nothing seemed simpler than to combine the two, thereby localizing supervision with the attendant reduction of working cost. The results of this combination were anything but a success. After months of harassing investigation for chemical and mechanical causes of trouble, I gave my attention to the physical aspect of the case, and, eventually discovered the absolute necessity for thorough aëration of the material under treatment before its immersion in the hot acid separating medium. An alteration in the scheme of working was immediately effected, so that the tailing from the crushing plant was divided, a portion travelling along a slowly moving endless rubber belt, inclined at such an angle as efficiently to drain off the associated mill-water, and the balance deflected to one or other of four circular tanks, fitted with false bottoms and similar in build to the ordinary cyanide vat. In these tanks, the material was thoroughly dewatered and, incidentally, efficiently aërated under a vacuum produced by the action of a small Penberthy injector. The subsequent operation consisted in mixing the vacuum-drained material with that from the inclined draining belt, in such a proportion that the intersticial spaces between the particles were filled with air instead of mill-water as formerly, and the now comparatively dry mixture was fed direct into the Potter plant. The improvement was instantly apparent and subsequent results were surprisingly successful.

In the 1000-ton test that followed this discovery conclusive proof was given that the Potter problem had at last been solved, and that the metallurgical difficulties of the Zinc Corporation were ended. All weights and assays were checked in the presence of the representatives of sellers of the material being treated and of the buyers of the concentrate produced. Considering that the plant was so re-modelled and patched up as to be almost unworkable, the results were most creditable, as the actual extraction for the whole run averaged over 81% of the zinc content, touching occasionally as high as 92·5%, when the aëration was especially good, with the production, in one continuous operation, of a high-grade concentrate assaying up to 46% metallic zinc.

Considerable excitement immediately followed, a state of affairs which, within the portals of the various Stock Exchanges as elsewhere, reflected itself in financial enthusiasm.

Shortly afterward, the Zinc Corporation and I parted company and the worries of the Potter process ceased to interest me. A new plant was erected, designed to embody everything tending toward mechanical and chemical efficiency. Unfortunately, however, the importance of the physical effects of aëration were completely overlooked. A rubber draining belt was part of the outfit, but the cyanide tanks and Penberthy injector were never put in commission. As might be expected the interstitial spaces of the material entering the Potter plant were charged with mill-water instead of being filled with air, and the general result was that the Corporation with prospects previously so promising found itself in what for a time looked like a hopeless position; the Potter process was vehemently denounced and the newly erected plant was ignominiously consigned to the scrap-heap.

In both these tests, as in all previous operations, no use was found for either exhaust-steam or oil, the water used in both the crushing mill and in the boiler for steam-heating the solutions being drawn direct from the Broken Hill mains.

The requirements for success in the Potter as in other flotation processes are: (1) That the sulphide particles, which are naturally greasy-faced, have clean, air-filmed surfaces, and be of a size not exceeding 1 mm. in diameter. (2) That there must be present, though not naturally added, some gelatinous or oily material for clotting the air-filmed particles together, and (3) that there be some means, mechanical or physical, of bringing these clotted masses to the surface of the immersing solution. The method adopted may be the mechanical entanglement of gas bubbles in the clotted masses or the physical expansion of the air films or entangled bubbles, or both, either under a vacuum or by the application of heat.

In many respects the main principles governing the success of each and all of the flotation processes are identical, the chief differences being in their method of application, and it seems more than probable that in these, as in so many other competitive schemes, the 'best' process will eventually be found to be the one that is operated by the brainiest men.

W. E. Simpson.

Zacatecas, Mexico, May 9.

Oil in California.

The Editor:

Sir—Referring to the article on this subject in your last issue, it may interest you and your readers to know more concerning the conditions governing the present boom in the northern oil-fields of California.

During the past year, notwithstanding a local production of over 57,000,000 barrels, the price of oil advanced from 50 to 65 cents per barrel, and no large amount of stocks accumulated, the total storage in California at the end of the year being somewhat under 20,000,000 bbl. Since January 1, the bringing in of the Midway-Sunset field has depressed the market, as it is impossible for the present pipe-lines to take care of the surplus, and the present price for oil in the various fields is not above 50 cents except on existing contracts.

Kern River, while slightly behind Coalinga in point of production, still maintains the lead as the most desirable field for operations. The productive area is being extended continuously northward and westward. In this locality the cost of drilling wells, the average depth of which is from 1000 to 1100 ft., is $7000, and a boiler-plant necessary to pump an area of, say, 40 acres, consisting of, say, 16 wells, would cost about $20,000. The production per well is roughly 30 to 50 bbl. per day, and the thickness of the oil sand is from 100 to 300 ft. The oil is of heavy gravity, running from 13 to 14 Beaumé, but it finds a ready market, being desirable for fuel purposes, and for the production of asphaltum.

Although this field has been opened up for 9 years, no well has, as yet, been exhausted, but many have been in difficulties, owing to water breaking in—due entirely to a lack of knowledge in the early days of how to use cement in obstructing the water. Lately, many of the wells stopped by water have been again placed on a producing basis by the introduction of air-jets, something after the style of the Pohlé pump.

The next district in point of production is Coalinga. This field is divided into two parts, known as the East side and the West side. Both are owned largely by the California Oil Fields, Ltd., the Standard Oil Co., and the K. T. & O., which is the Southern Pacific

Operating Co. The wells reach a depth of some 2000 to 2500 ft., and cost in the neighbourhood of $20,000 to drill. Boiler-plants are not necessary, as the individual wells are all operated by gas-engines, the field producing sufficient gas to provide for local operations. The production of a well will average 150 bbl. per day, and the oil is of light gravity, running over 20 Beaumé.

The East side is being extended slightly northward and quite considerably to the southeast. The discovery on the property of the Coalinga Mohawk, during the month of March, has greatly extended the possibilities of increased production.

On the West side there is little available property to be had, the drilling of the first tier of wells, or that nearest the outcrop, having been practically completed. The wells cost in the neighbourhood of $6000 each, and are easy to drill, the drilling being completed in 30 days. The depth does not exceed 1000 to 1200 ft., but as the companies extended their operations to eastward the depth increased until now the wells are more than 2000 ft. deep, and are costing about $20,000 each, and it will take from 4 to 8 months to properly bring in a well. The grade of the oil is better than in the shallower wells, but it is not bringing a higher price. This field has not been extended south beyond Section 6, which was partly developed three years ago, although more wells on the various sites have been drilled.

The transportation facilities from Coalinga are excellent, and there are no large stocks of oil in this field.

The next district of importance is the Midway-Sunset. This field threatens to disturb the local conditions for some time. The original drilling gave shallow wells of about 1000 to 1200 ft., yielding heavy oil, but during the past three months a lower stratum of sand has been perforated, and some large gushers have resulted, notably the Lake View, which, for the past 60 days, has been producing at the rate of 42,000 bbl. per day. The Standard Oil gusher produces some 10,000 bbl. per day. The Mays produces a large quantity, and the K. T. & O. some 6000 barrels.

The pipe-line companies are wholly unable to take care of this enormous quantity, although fortunately, the Union Oil Co., which dominates the Producers Pipe Line Co., controls the Lake View gusher, so it has been in a better position than any of the others to take care of this extraordinary production. It is understood that the Standard Oil Co. has purchased some 40,000,000 bbl. of oil in this field, and is the controlling factor in the output and price. It is rumoured that the Standard people are going to duplicate their pipeline; if this proves correct, it is not likely that further pipe-lines will be run into this country, and the result will be that parties not having a contract with the Standard Co. will have to sell their oil at what they can get for it. As the oil produced in this field is generally used for refining purposes, it has a much more limited market than the heavier oil used for fuel purposes. I expect to see a great drop in prices in this locality, and a corresponding drop in land-values.

The next field of importance is the Santa Maria, but no great discoveries have been made, although it is rumoured that the Los Flores have lately discovered oil on their large tract of land. The Palmer has not been successful with additional wells, until recently.

The consolidation of the Graciosa with the Oil Port refinery, and the lands owned in Mackittrick by Yanicey and associates, may result in connecting Santa Maria field with Mackittrick, by means of pipe-lines, and the result will be to give the Mackittrick field a fresh impetus. As yet, nothing extraordinary has happened in this last-mentioned field, although drilling has been going on continuously. Mackittrick last year was credited with a production of 5,000,000 bbl., but some of this production should be credited to Midway.

The past year has seen the advent into the oil business, either actively or financially, of a large number of prominent mining engineers: in the West generally mining operators have turned their attention to oil, the production of which at the present time exceeds in value that of gold. The output of oil in California this year should exceed 60,000,000 bbl.

It may interest you to know something regarding the value of oil-land in the various fields.

In the Kern district, proved land commands a price of $5000 per acre. This is based on one-third of the territory being drilled, and the balance absolutely proved.

In the Coalinga district, unproved land, but fairly well located, sells from $1000 to $1500 per acre. Proved land is worth about the same as in Kern county.

In Midway, reasonably well proved land sells for $1500 to $2500 per acre, but I expect to see this figure much reduced in the next 12 months.

In Mackittrick, well located land is offered at about $1000 per acre.

In Santa Maria, well located land is offered at \$1500 an acre, and large tracts can be purchased as low as \$300 to \$400.

While the owners of land usually demand spot cash for their holdings, they are not receiving it, and most of them are what might be called 'land poor.' They are holding the price of the land at a high figure, without any means of developing it, and it is only a question of time when this will regulate itself, and owners will be forced to make reasonable terms, and give reasonable time for exploratory work.

THOS. J. BARBOUR.

London, May 31.

Tin in Northern Nigeria.

The Editor:

Sir—In view of the attention now being paid to the tin placers of Northern Nigeria, a little first-hand information concerning this region may be of interest to your readers. I have recently spent 16 months on the spot, and am familiar with all the local conditions.

This is not West Africa in the ordinary sense, but rather the Western Soudan, in Lat. 10° to 11° N., about due west of Khartoum. The climate is good, the elevation being 3500 to 4500 ft. above sea-level, with hills rising to 6000 ft. Horses and cattle thrive, and many of the natives are mounted. Donkeys, bullocks, and horses are the native pack-animals; the small donkey is a useful little fellow and a large proportion of the native trade is carried by him, especially salt, grain, and kola nuts. The shade temperature varies between 70° and 104° F. The nights are cool. In going to this mining district the fever country is traversed, but this is accomplished on stern-wheel steamers in five or six days, and with ordinary care there should be no danger of infection from the bites of the anopheles mosquito. Not infrequently a mining engineer who has been in fever countries and carries the disease in his system becomes so over-tired by exposure to the sun, as to suffer from fever really contracted elsewhere. I have known men condemn a healthy place for this reason. A man should be careful of the sun in Nigeria; even a slouch hat, such as is worn in Australia, where the heat is often greater, will not give adequate protection. Fairly thick clothes should be worn when riding in the heat of the day.

The country is open, like the South African veldt, with thicker bush lining the water courses. Ample water is available; one need never go many miles without being able to camp near good water.

The sport, especially for winged game, is good in places. Partridge (franklin) and guinea-fowl are common, with duck and geese on the larger rivers and swamps. A shot-gun is most useful to supplement with game the beef, mutton, fowls, milk, and butter, with which it is possible to stock the larder.

The natives are easy to handle and make excellent unskilled labourers. The supply is ample. Properly handled, they are as good a type as you can find in any part of Africa. At present the pagans do not come in freely except from Bornu; later the Bauchi pagan will make a splendid boy, as he is a worker.

The possibilities for lode mining are as yet untried, but good indications have been found, although serious prospecting has been done only in one small corner.

The placers are rich; although deep heavy wash is not common there is plenty of 10 and 12 ft. ground that is highly profitable even under present conditions. When the district is well opened up, I anticipate important results. Good and lasting work is never done in a hurry and there remains much careful organization to place the industry on a satisfactory basis. Transport has to be systematized, proper staffs collected, machinery and tools despatched, and all the really important work of organization and administration, without which sound and profitable mining is impossible.

We hope to take £10 per ton off the present cost of transport as soon as the new route to the field is available. The Baro Kano railway, on which splendid work has been done under the direction of Mr. John Eaglesome, will soon reach the terminus of the road into the fields, and the question of a railway right into the district is under discussion.

Labour costs one penny per hour, horses £2 to £10, bullocks £2 to £3, donkeys £2, sheep 3s. to 4s. 6d. Transport from London costs £25 per ton, including insurance. Personal servants are fairly good; it is always well to use natives from the interior and to pick up the language (Hausa); Arabic will be found useful when dealing with the more educated natives.

Mining and prospecting rights are obtained direct from the Government.

L. H. L. HUDDART.

London, June 1.

In Tasmania Mount Bischoff is belying doleful expectations. This tin mine has been working since 1873 and was believed to be on its last legs, but the general manager now reports that 3,000,000 tons of ore are available.

MANGANESE MINING IN THE CAUCASUS

By AUGUST MULS

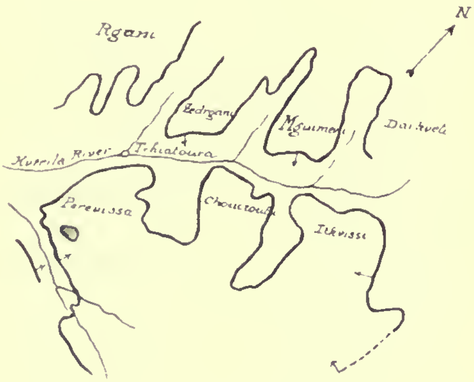
THE manganese deposits in the Caucasus are situated along the river Kvirila, in the neighbourhood of Tchiatoura, a village in the district of Koutais. They are found on the top of horizontal or slightly inclined strata of limestone and show regular and interstratified beds. These beds are the simplest kind of ore deposit conceivable and form the upper part of the tablelands through which the river Kvirila has found its way. They are covered by thin strata of limestone and a few metres of arable soil, which even disappears in places. On the slopes of the valleys and wherever a depression exists there are manganese outcrops. The thickness of the beds is easily ascertained; it ranges from 2 to 4 metres and shows small strata of inferior ore mixed with argillaceous sand. As a general rule, only the lower part of the bed, for a thickness of $1\frac{1}{2}$ to $2\frac{1}{2}$ metres, is worked; this contains the richest and purest stuff in the shape of a compact or pisolithic mass, sometimes also of amorphous blocks. In chemical composition the ore ranges from 45 to 60% manganese, in the form of black oxide, 5 to 12% silica, about 0·18% phosphorus, and small percentages of other elements.

Tchiatoura is the largest town in the manganiferous district and lies toward its south-western boundary. The other mining localities on the right bank of the Kvirila are Rgani, Zedrgani, Mgvimevi, and Darkveti; on the left bank are Perevissa, Choucrouti, and Itkvissi. The whole area is about $13\frac{1}{2}$ miles long by 6 miles wide, with a total area of about 81 square miles. According to the geologists who have explored the country, the Tchiatoura district contains the largest reserves of manganese in the whole world, and although considerable exports have taken place ever since the discovery in 1878, it is estimated that more than 250,000,000 tons are still available.

In no part of the world would it be possible to find more characteristic mining. There is no concentration of property in the hands of capitalists as in America, Mexico, or South Africa. With the exception of two or three European companies, one searches in vain for any methodical organization for the extraction and transport of ore, nor does any commercial spirit, in the modern sense, direct the handling of this mineral wealth.

Although the Caucasian manganese deposits, through their regularity and concentration in a relatively small area, are peculiarly adapted to monopoly, they remain for the greater part in the ownership of peasants and noblemen who work their property themselves or lease it to other natives. Thousands of small holders are thus extracting the ore for their own account on a small scale.

Owing to the nature of the deposits the work is easy. With no other tools than pick and shovel they dig galleries at random, using but little timber, so that the miners are obliged to leave portions of the ore untouched. On the other



hand they have no scruple in annexing as much as they can from their neighbour wherever convenient. Sometimes a rough hand-picking or sifting takes place on the mine in order to remove the silicious stones and dust containing impurities. Then the ore is conveyed by horses or bullock-carts to the next 'platform' in the valley, where it is sold to merchants and exporters.

It is almost incredible that the hundreds of thousands of tons of ore that Poti delivers every year to the world's metallurgy, in cargoes of from 3000 to 8000 tons, are almost entirely brought down from the mines, *pood* by *pood*, over steep winding rocky mountain-paths and broken muddy roads.

All the exporters are in possession of 'platforms,' where they accumulate the mineral brought from the mountain. These 'platforms' are simply prepared spaces with a shelter for a weighing-machine. The buyer's clerks examine the ore, reject the inferior quality, and pay for the accepted stuff by weekly instalments at so many *kopecks* per *pood*. They do not analyse the ore, judging its approximate quality on sight.

The platforms are nearly all situated along the small railway crossing the mining district and running from Satchkeri to Charapan on the main road to Poti; their superficial area and the quantity of ore stocked on them are the best standard of the shipper's importance and power. The railway follows the valley of the Kvirila, which winds between steep mountain-sides. At convenient points space is left between the track and the river or the mountain-side, and here sidings are placed. The ore is heaped to a height of a few metres. The platforms belong to the Government or to private people who have acquired them at high prices and hold them zealously.

Manganese mines at Darkveti.

The ownership of extensive stocks is of the utmost importance to the exporter, for, from time to time when the quantities of ore wanted for export exceed the carrying capacity of the rolling stock at the disposal of the small railway, the Government officers make a periodical (generally monthly) allotment of trucks in proportion to the importance of the stocks owned by the exporters. This practice has the effect of checking the efforts of the smaller men who would wish to have a share of the export and practically leaves the foreign trade in the hands of half a dozen firms.

A few European firms have settled in the Tchiatoura district; they are the Schalker Gruben und Hutten Verein of Gelsenkirchen (Germany) (this company exploits the ore solely for its own consumption); Forwood Bros, Panassié (a French concern); and the Industrial & Commercial Co., of Antwerp. The two latter have erected washing and cleaning plants and produce high-grade ore. The plant and premises of the Industrial & Commercial Co. are the most important and as they are equipped with up-to-date machinery and conducted on modern lines, deserve special mention. The ore is conveyed from the mine to the works in the valley by an overhead cable and tipped into the receiver of a Krupp washer, where it receives a preliminary washing to remove mud and any impurities adhering to the blocks of ore. It is then conveyed on to a Cox sieve, where it is separated into six different sizes. The large lumps find their way onto a dressing-table where a hand-picking takes place and the silicious stones are removed. Four other sizes are conveyed to piston-troughs and the smallest size flows with the water into a series of spitzkasten; after going through these each quality is run down in trucks to the platform whence it is removed as required for shipment. This plant, working day and night, is capable of turning out yearly about 100,000 tons of ore containing 53 to 54% manganese, whereas the crude ore, as extracted from the mines, generally carries about 48%. In 1909 the total export of manganese ore from Poti was 545,000 tons.

Washing plant in the valley.

New Zealand. The dredges in Otago and Southland during 1909 won 36,503 oz. as against 40,264 oz. in 1908, 77,187 oz. in 1905, and 106,369 oz. in 1902.

MILLING OF LEAD-SILVER ORE. II

By GELASIO CAETANI

GENERAL REMARKS ON JIGS: All the jigs in the mill have been built on the following principles:

(1) Standardizing of machines.

Only two types of jigs are used, and these are of almost identical construction. The shafts, bearings, eccentrics, plungers, and plunger-rods, sieve-frames, gate and dam discharges, hutch-gates, etc., are uniform throughout the mill.

(2) All jigs are double, but each individual jig is independent of its mate, a 4 in. air-space separating the two machines.

(3) The tongues and grooves are painted with white lead; the inside of the plunger and sieve compartment is also painted and then completely lined with ¾ in. boards.

(4) All wearing parts are lined with ⅛ in. steel; the hutch-boxes are wide and deep; the working-floor is kept at about 34 in. from the edge of the jig.

(5) There are two idle reserve jigs to which the pulp can be diverted whenever repairs are necessary on one of the working jigs.

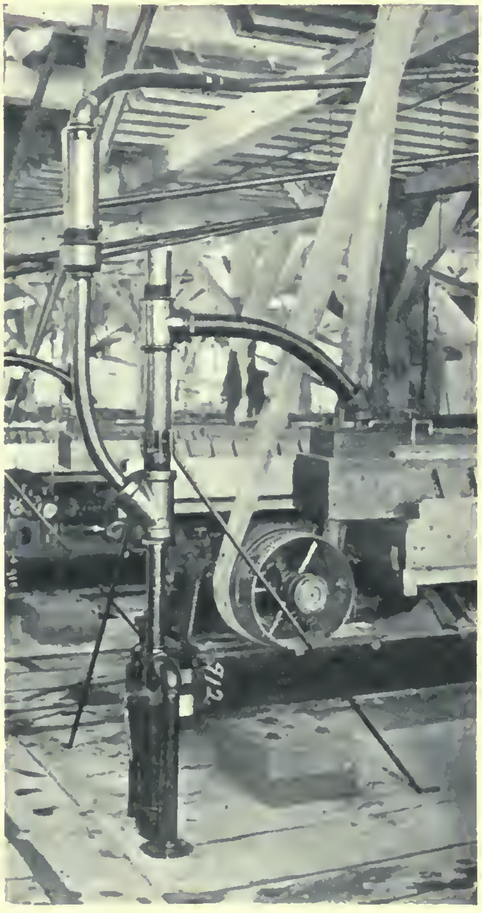
(6) A heavy drop is used between compartments. This allows the jigs to carry an overload without becoming choked and loosens the head of the ore-bed. In the classifying-jigs the inside of the sieve-frame must be flush with the outside of the liners that hold it in place. If the frame sticks out even a little, an eddy forms along the walls of the sieve-compartment, and the fine sand works down along these walls and eventually gets into the hutch.

NOTE: The action of the jig-bed can be tested by a simple method. A ¾ in. nut is tied to a thread and placed on the jig-bed. After a certain time the nut will have settled on the sieve, as can be noticed by making a reference mark on the thread to which it is tied. By comparing the time required for the settling of the nut, it is possible to determine the action of the jig-bed in every place and, as it were, to survey the whole bed.

OUTLINE OF CONCENTRATION: The mill-feed, as shown in the flow-sheet, Fig. 2, is divided by trommels into a 30 to 10 mm. and into a 10 to 0 mm. product. The first of these products is fed to five bull-jigs and the second to four classifying-jigs.

The bull-jigs separate the following products:

(1) 1st cup concentrate @ 52 to 59% lead.
(2) 2nd cup concentrate @ 40% lead.
(3) 3rd and 4th cup middling @ 8% lead.
(4) Tailing @ 1 to 1·4% lead.
(5) Hutch-discharge @ 25% lead.



Pipe Classifier.

The classifying-jigs separate the following products:

(6) 1st cup concentrate @ 65 to 73% lead.
(7) 2nd cup concentrate @ 40% lead.
(8) 3rd and 4th cup middling @ 10% lead.
(9) 5th cup middling @ 5% lead.
(10) Slime-discharge from 1st compartment @ 14% lead.

(11) 1st hutch-discharge @ 55% lead.
(12) 2nd hutch-discharge @ 30% lead.
(13) 3rd 4th and 5th hutch-discharge @ 7% lead.
(14) Tailing @ 1·4 to 1·8% lead.

These 14 products are distributed to various parts of the mill as shown in the flow-sheet, and in the following pages I shall give the reason for the metallurgical treatment to which these products are individually subjected.

In a general way these products can be divided into four classes:

(A) Concentrates, which are either shipped direct or undergo a further process of reduction and concentration with a view to raising the grade of the shipping product.

(B) Middlings, which are crushed and concentrated several times in succession with the object of separating the galena as fast as it is liberated by crushing. This operation is carried on until the whole bulk of the middlings is made to pass through a screen of 0·6 mm. aperture, when it is classified and concentrated on tables.

(C) Tailings, which it would be unprofitable to handle further.

(D) Slime that joins the product (B) before it enters the table-concentration department.

(A) COARSE CONCENTRATES: The coarse concentrates discharged by the first cups of the jigs (Products No. 1 and 6) are shipped direct to the smelters. The concentrates discharged by the second cups (Products No. 2 and 7) assay about 40% lead and could also be shipped to the smelters, but it is more profitable to grind these products through 20 mesh and then raise their grade by table concentration.

This procedure is due to the fact that a 40% lead product contains about 50% gangue, chiefly iron carbonate. The smelters do not pay for the iron content of the ore; on the contrary, they charge about $11 for freight and treatment, thereby heavily penalizing the iron carbonate in the concentrate. Hence it becomes profitable to eliminate as much as possible of the gangue by table-concentration, even if some lead be lost in the tailing. The economic limit of this separation is reached when the tailing assays about 11%, as at this point the value of the lead lost offsets the profit resulting from the reduced freight and treatment charges. In practice, about 25% of the concentrate is eliminated as tailing, assaying 7% lead; the grade of the concentrate is raised about 11 units and a very material profit is made per ton of concentrate treated.*

HUTCH-CONCENTRATES: A disadvantage of jigging unsized products is that a certain amount of fine low-grade sand passes through the sieves with the hutch-concentrates. This is shown in the following analysis of the first hutch-product of the classifying-jigs:

	Weight %	Lead %
On 20 mesh	3·2	82·1
On 40 mesh	16·8	67·7
On 60 mesh	14·2	50·3
On 80 mesh	19·2	42·7
On 100 mesh	12·6	39·6
On 150 mesh	13·4	42·7
On 200 mesh	7·6	49·4
Through 200 mesh	13·0	58·8

This analysis shows that the coarser sizes are high-grade and the finer sizes low-grade, which is exactly contrary to the result of analysing the product of a hydraulic classifier. The hutch product is what I call a 'counter-classified' product and it is easy to see that it can be divided by proper hydraulic classification into a high-grade, coarse discharge, and a lower-grade, fine overflow. This is what is done with the first and second hutch-products of the classifying-jigs. The hutches are spouted separately to dewatering tanks, which deliver through spigots a constant-volume to two sets of pipe-classifiers (See Fig. 6). The overflow of the dewatering-tanks is used as hydraulic water for the pipe-classifiers.

The work of the pipe-classifiers is exhibited by the following table:

Classifying Jigs.

1st hutch 55% Pb	2nd hutch 25% Pb
Divided by pipe-classifier into	Divided by pipe-classifier into
Discharge 77% Pb; Overflow 49% Pb	Discharge 60% Pb; Overflow 12% Pb

Thus the pipe-classifiers actually concentrate the hutches. The discharges are sent

* A mathematical discussion of this problem by the author appeared in the *Mining and Scientific Press*, January 1, 1908, entitled 'Relation between the Assay-Value of Mill Products and Smelter Contracts.'

direct to the bins while the overflows are fed to Card concentrators, there being one Card to each classifier. The pipe-classifiers are quite stable, they call for little attendance, and yield a concentrate remarkably free from low-grade sand.

(B) MIDDLINGS: The jig middlings are chiefly composed of iron carbonate; they assay: 7 to 10% Pb, 3 to 4·5 oz. Ag, 29 to 32% Fe, 9 to 5% SiO_2. A large tonnage of middling is generally shipped to the smelters, which buy it as iron ore and pay for more than half of the lead and silver contents.

There is more profit in shipping the middling direct to the smelter than in milling it, as the recovery on re-ground middling is only about 55% for the lead and 50% for the silver. Some profit results from the reduced load and wear on the concentrating machinery; the power consumption also is lessened.

The bull-jig middling, which is never shipped, because too silicious, is sent to a set of 14 by 36 in. rolls, which crush it to pass a 10 mm. screen. The crushed middling is screened on one 10 mm. trommel, the under-size being fed to two classifying-jigs called the 'middling-jigs.' These work exclusively on crushed middling, and by watching them it is possible to keep account of the tonnage and grade of the middling separated on the bull-jigs, and also to know what portion of the middling, after crushing, is separated as concentrate, as middling, and as tailing. This is not possible when the crushed middling is returned to the original feed, as is customary in a great number of mills. This idea of not returning the middling to the machine that has separated it, has been adopted as a vital principle throughout the mill. It not only has the advantage of not crowding the machines with a hybrid mineral, but also that of allowing a confident judgment concerning the cleanliness of the separation.

The middlings of the classifying-jigs (Products No. 8 and 9) and the hutch-product No. 13 are crushed separately through fine rolls. The crushed product has the characteristic that practically all the galena freed by crushing is to be found in the fine sand and slime, and that the over-size of a 22-mesh screen (0·6 mm. aperture) does not contain sufficient free galena to make it worth while to attempt concentrating the over-size before re-grinding.

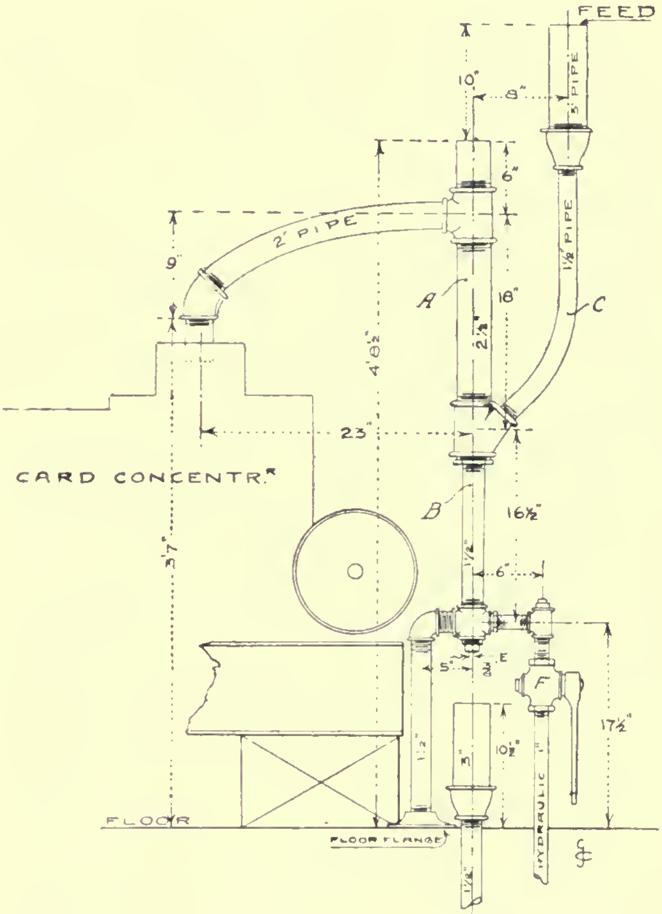


Fig. 6. Pipe Classifier.

Description		Volume Litres per. sec.	Gal. per. min.
Feed	C	0·374	5·82
Column	A	0·586	9.25
"	B	0·211	3·34
Spigot	E	0·300	4·74
Hydr. Water	F	0·511	8·07

Sorting Velocity: 185 mm. per second.

These crushed middlings, therefore, are passed over a 22-mesh screen, the over-size of which is sent to Huntington mills and ground to pass 22 mesh. The screening is performed in two steps: first, by a 2 mm. trommel, which separates all the coarse material, and then by revolving Bunker Hill screens. The trommel takes off a large part of the load from the fine screens, elevators, launders, etc. It is also possible to return the over-size of the trommel and screens to the middling-jigs whenever the Huntington mills get choked.

The crushing of the middlings is performed in three steps: first, by coarse rolls, then by fine rolls, and finally, by Huntington mills; and at each step the free galena is separated either by jigging or screening. This reduces the amount of slime produced and especially the amount of galena slimed.

(C) TAILINGS: About 33% of the pulp is separated by the jigs as coarse tailing, and 40% as middling. The value of the tailing is chiefly due to particles of galena clinging to quartz fragments and to some iron carbonate that has not been separated as middling. The first loss is unavoidable, as the specific gravity of quartz containing some galena is not sufficient to make these particles settle with the heavy iron carbonate. The latter itself is always lead-bearing and to obtain clean tailings it would be necessary to separate *all* of the iron carbonate as middling. This is not always possible as the tonnage of middlings is at times so heavy that the crushing and grinding capacity of the plant is overtaxed. It must also be kept in mind that the last middling to be separated is the lowest grade, assaying about 3% lead, and that the galena is so finely disseminated as to be almost invisible to the naked eye. The extraction to be expected from these particles is therefore very low, probably less than 20%, and the recovery would not pay for the cost of treatment. In the old mill, where the crushing capacity was limited, a large amount of middling was allowed to escape with the tailing; hence the North mill has been built and is being put in operation with the object of re-jigging the old tailing-dump, and to grind and concentrate the middling separated by jigging.

(D) THE SLIME separated on the first jig-compartments is screened on an inclined screen, which separates practically all of the fine wood-pulp contained in the ore. This inclined screen, which in some mysterious way has been baptized by the mill-men with the name of 'piano,' is shown in Fig. 7 and has proved to be one of the most simple, efficient, and fool-proof devices in the mills. The main principle consists in feeding the slime tangentially to a curved screen. The slime passes through the screen owing to the centrifugal force and the wood-pulp is continually washed ahead and occasionally raked off. The slime discharges into a spitzkasten that splits it into sand and vanner-slime, which flow to the table-concentration department.

HARZ *v.* HANCOCK JIG: During the past year the Hancock jig has been introduced in the Cœur d'Alene. Several of these machines are now in operation at the Morning mill and are giving great satisfaction on ore that is difficult to concentrate. Comparative figures are not yet available, but it is probable that the Hancock jig will be installed in one of the Bunker Hill mills. From the data at present available it appears that the Hancock jig does not perform closer work than the Harz jigs of improved pattern used at the Bunker Hill, and that, if installed, it will be chiefly on account of the large saving of power, floor-space, and water.

Table Concentration.

OUTLINE AND PRINCIPLES OF CONCENTRATION: The feed to the table-concentration department comes from the jigs and consists of the jig-slime and the classifying-jig middlings, which have been crushed by rolls and Huntington mills to pass a 22-mesh screen. This pulp is elevated to a slough-off tank, the discharge of which feeds four Bunker Hill revolving screens. The over-size is returned to the Huntington mills, so that all the material entering the table-concentration department must have passed through these 22-mesh Bunker Hill screens, which have a 0·6 mm. aperture. This pulp therefore consists almost exclusively of carbonate of iron and galena, and the two minerals are so intimately mixed that the separation cannot be perfect.

The total supply to the tables will average about 8% lead and the total tailing will average close to 3·5% lead. The lead extraction varies between 55 and 60%, which is the best that can be obtained by grinding the middlings to 0·6 mm. maximum size. Screening-analyses of the tailings show that the grains of sand when perfectly clean from free galena, will assay from 1·3% lead for grains 0·2 mm. diam. to 3·5% lead for grains 0·6 mm. diam. The included galena is so minutely disseminated that to obtain a higher extraction it would be necessary to grind finer; but by doing so a great part of the galena would be slimed and lost. The slimed galena is so difficult to recover that, after three years almost continuous experimenting with the various slime concentrators on the market, the problem is still unsolved, and the 6-ft. Frue vanner remains dominant.

The under-size of the Bunker Hill screens is classified on Duplex classifiers and slime classifiers into four products, distributed by classifying pocket-launders to Card concentrators, which separate the pulp into concentrate, middling, tailing, and slime. These products are re-handled and cleaned as shown on the flow-sheet.

Certain fundamental principles have been followed in planning the mill and apply especially to the table concentration. These principles are :

(1) In grinding, the free galena will concentrate almost exclusively in the fine. Therefore the over-size can be screened out and sent to the fine-grinding machines without first undergoing a process of concentration.

(2) Not to require from any single machine a thoroughly clean work, but to have each operation of screening, classifying, or concentrating repeated by other machines on each single product of the first machine. This is a most important and fundamental principle. Each machine, though doing as clean work as possible, acts as a roughing machine for the next following one, which in its turn, treating material that is better prepared, performs a better

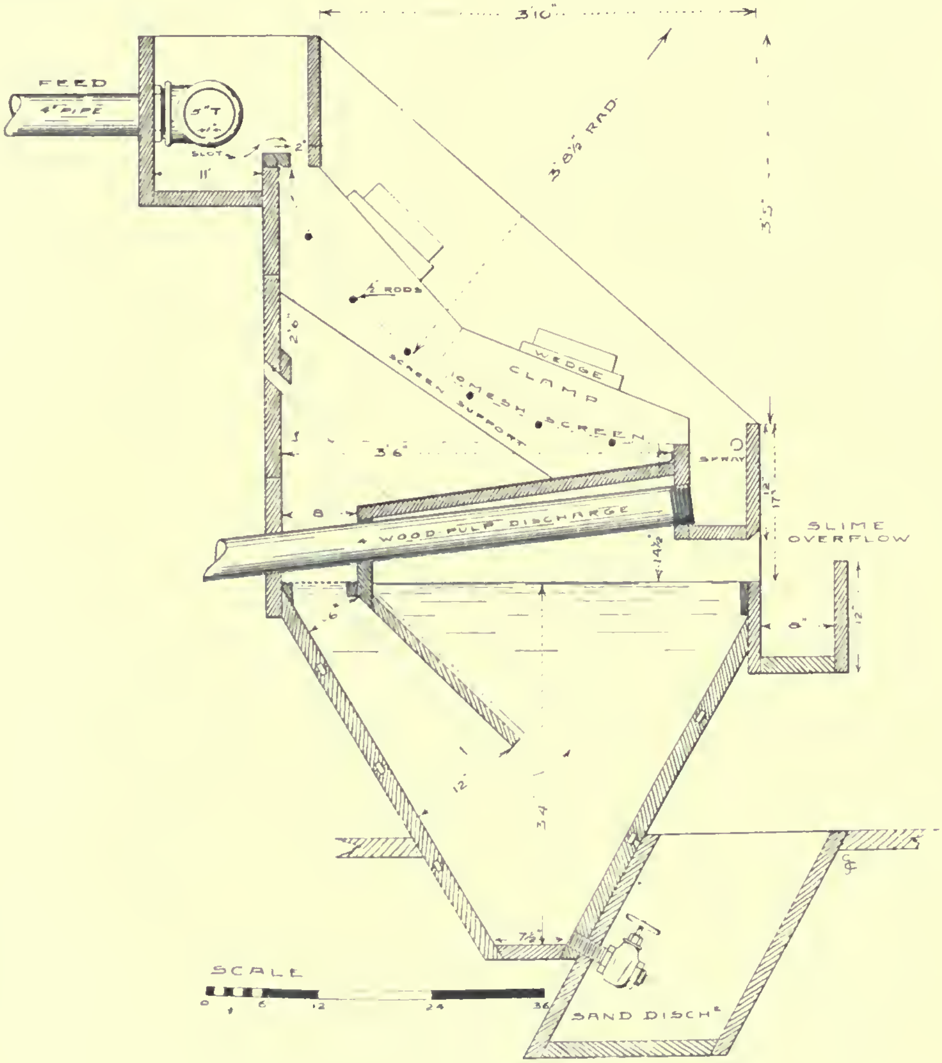


Fig. 7. INCLINED SCREEN FOR SEPARATING WOOD-PULP.

class of work. The advantage of this method is also that wider variations are allowed in the work of each individual machine, as any defective work of one machine is corrected by the next following ones.

This principle is illustrated by the screening and classifying arrangement used in the West mill.

(1) The 2 mm. trommel separates the bulk of the coarse sand, chips of wood, etc., from the pulp flowing to the sloughing-off tanks and the Bunker Hill screens. The sloughing-off tanks eliminate a large part of the slime and water from the Bunker Hill screen, which, thus freed of the coarse sand and of the excess water, is subjected to less wear and performs better work.

The slimy water, sloughed-off by the tanks, lessens the work of the hydraulic classifier and subsequently the amount of slime to be separated by the Card tables. The Bunker Hill screens, by eliminating the coarse sand, lessen the work of the classifiers and tables.

The classifiers (which use little wash-water) separate the bulk of the slime and classify the sand into four products. Each of these products is roughly re-classified in the pocket-launders and then completely deslimed by the Card tables.

The slime, separated as described above, flows to the settling-tanks. This slime, by the repeated settling and by passing through several safety screens, is deprived of the only two things liable to cause trouble, namely, sand and foreign matter. It is therefore possible to use small spigots on the settling-tanks and considerably to thicken the pulp fed to the vanners. The vanner-tailing is settled again, and run over a set of tailing-vanners.

(2) The same principle is applied to concentration. The Bunker Hill screen enriches the pulp by eliminating the low-grade oversize. The Card tables make the first separation of concentrate, middling, and slime, which go respectively to the grading and middling-tables and to the slime-classifiers. The grading tables eliminate any middling that may have remained in the concentrate; the middling-tables any concentrate that may have remained in the middling; the slime-classifiers any tailing sand that may have run into the slime. Therefore, any error committed by the first set of Card tables will be corrected on the second set of machines.

The same principle is applied to the grading of the coarse jig-concentrate, which contains a considerable amount of coarse gangue. By grinding and re-concentrating this concentrate on Card tables, a large amount of middling can be separated and the grade of the ore raised; this middling is cleaned again on a middling-table, as shown in the flow-sheet. Each ton of barren material, thus eliminated, represents to the company about $10 saved in freight and treatment-charges. Also the hutch-concentrates of the classifying-jigs are graded by hydraulic classifiers and Card tables, as previously described.

(4) Another principle followed in the designing of the mill is to give to each machine the greatest possible independence, by arranging that most of the pulps can be switched temporarily into other channels or on to other machines.

To a limited extent, arrangements have also been made to treat one product in more than one way if the character of the ore, or troubles with any machine, require it. As an example, the classifying-jig middling can be sent either to the rolls, or shipped to the smelter, or passed directly to the Huntington mill. So also, the 2nd jig hutch can be raised to shipping grade and sent directly to the bins, or concentrated by pipe-classifiers and tables, or turned into the hutch-middling.

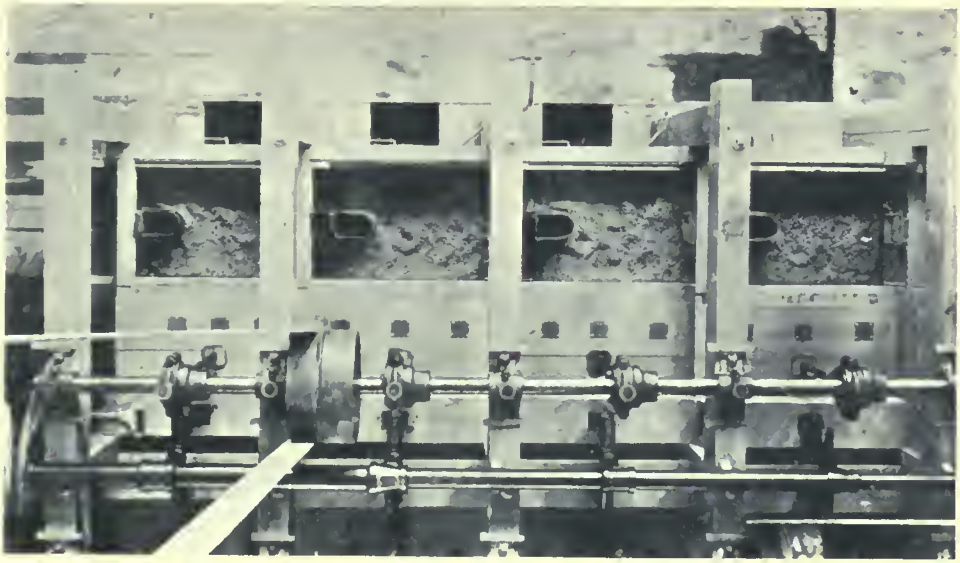
(5) The principle, previously discussed, of never returning to a machine the middling produced by the machine itself, is applied to the Card tables as well as to the jigs.

(6) It is more convenient and more efficient to separate the slime from the sand on the Card tables, than to attempt to do it completely by hydraulic classification. When separating the slime from the sand on a table practically no wash-water is used as the slimy water simply drains off from the sand, whereas to separate the slime from the very fine sand by hydraulic classification requires an excessive volume of wash-water.

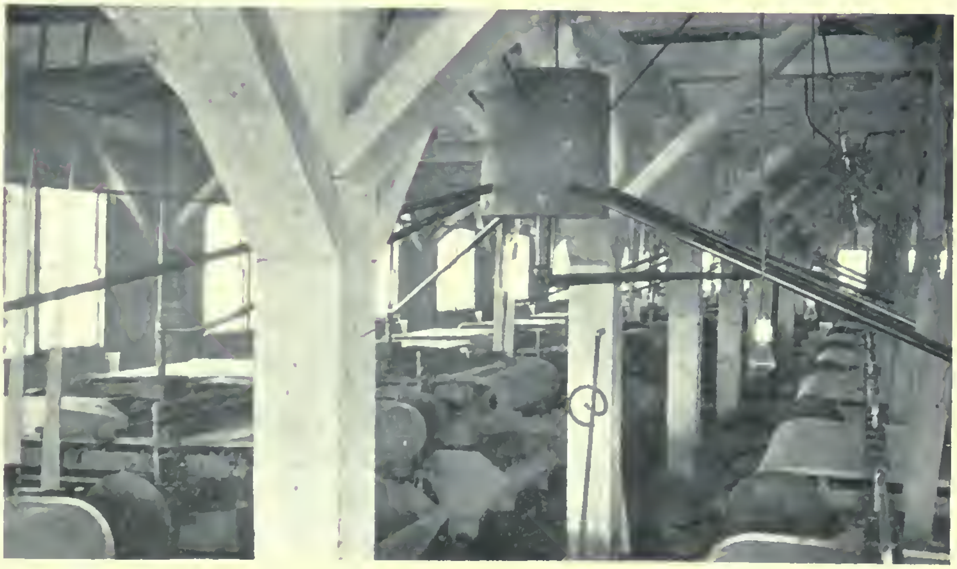
(7) The Card tables are more efficient than any form of vanner for the finest sizes of sand. The Card table will take out of the slimy pulp all the sand that it is able to handle; the rest will be separated as 'outcast' material with the slimy head-water and sent to the vanners.

(8) The settling-tanks must be kept outside the mill. This excellent practice is widely adopted in Arizona, for obvious reasons: It keeps the slop and drip of the tanks away from the machinery, and the heavy tanks are not affected by the vibration of the mill. The B. H. & S. slime will flow on a grade of $\frac{3}{16}$ in. per foot, and therefore the loss of head, in running the slime out of the mill and back, is not great.

(To be continued).



PLAN OF CLASSIFYING-JIG SHOWING CENTRAL-DISCHARGE CUPS.



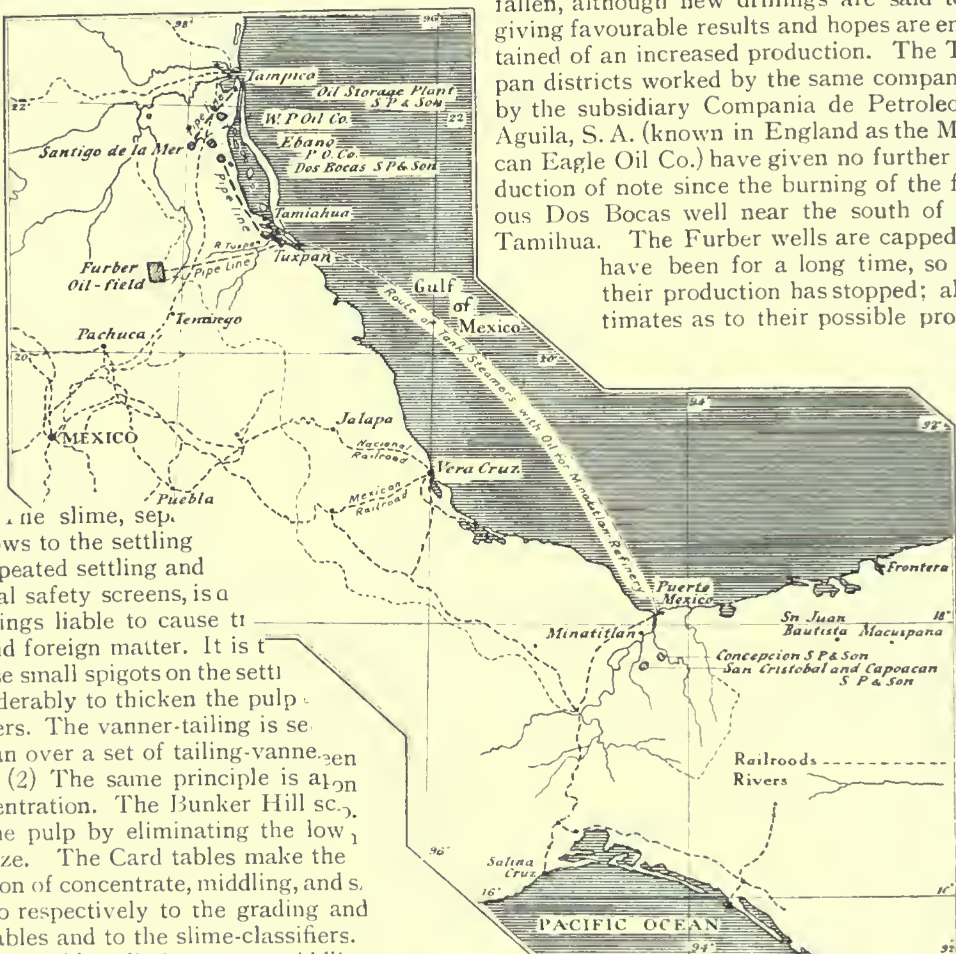
BARREL-DISTRIBUTOR TO FRUE VANNERS.

OIL IN MEXICO

By J. L. MENNELL

WITH oil booming, the production in Mexico has attracted attention in America and England, and some account of the oilfields will therefore be of interest. 18 months; but as yet this has resulted in no large productive wells. The output from the wells of the Pearson company in the San Cristobal and Capoacan district has indeed fallen, although new drillings are said to be giving favourable results and hopes are entertained of an increased production. The Tuxpan districts worked by the same company or by the subsidiary Compania de Petroleo del Aguila, S. A. (known in England as the Mexican Eagle Oil Co.) have given no further production of note since the burning of the famous Dos Bocas well near the south of lake Tamihua. The Furber wells are capped and have been for a long time, so that their production has stopped; all estimates as to their possible production when the pipe-line into Tuxpan is completed can be nothing but a guess. Further north, in the Tampico district, are the wells from which the chief production has come, namely, those at Ebano and Huasteca, belonging to the Doheny interests. The Mexican Fuel company (Waters-Pierce) has also a property in this district, but has a small production as yet.

The general quality of the oil so far found has not been good. The Ebano oils are heavy



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Name of Company	District of operations	Present output in barrels (42 American gals.) per day	Owners controlling, prospective production, etc.
Mexican Petroleum Co.	Ebano, on the Mexican Central Railroad, near Tampico.	6000 to 7000 bbl. per day.	Doheny interests. Production has been steady for more than two years. Oil of heavy grade more adapted for fuel.
Huasteca Petroleum Co.	Huasteca, 100 kilometres south of Tampico.	500 to 1500 bbl. per day.	Doheny interests. This producer is of only recent acquisition. Good prospects of continuing. Oils of light grade suitable for refining.
East Coast Oil Co.	Mendez, on Mexican Central Railroad, east of Ebano, on Panuco river, 20 miles west of Tampico.	Practically nil as yet.	Harriman interests. Doing prospecting work.
Cia. de Petroleo del Aguila (Mexican Eagle Co.)	Potrero, near Tuxpan. Tanguijo, near Tamihua, in Vera Cruz.	Practically nil since burning of Dos Bocas	Pearson interests. A well at Tanguijo recently brought in, oil of good light grade, but possible production not yet known.
S. Pearson & Son.	San Cristobal and Capoacan, about 25 miles from Puerto Mexico, on the Coatzacoalcos and Cochapa rivers.	400 to 500 bbl. per day.	These wells gave much more oil two years ago, reaching 12,000 bbl. per day. Recent reports give further hopes of output again rising through new oil-wells struck in the district. Refinery at Minatitlan for 3000 bbl. capacity.
Oil Fields of Mexico.	Furber, S.W. of Tuxpan.	Wells are capped pending completion of pipe line for 12000 bbl. daily to Tuxpan.	Percy N. Furber interest. Estimates of probable production from these wells varies greatly, possibly 4000 to 5000 bbl. Other estimates place possible output at a few hundred barrels per day.
Mexican Fuel Oil Co.	20 miles west of Tampico on Tamesi river and 15 miles west of Tampico on Panuco river.	Nil.	Belong to Utah interests. Doing prospecting work only as yet, and not reached any production.
Mexican Fuel Co.	Topila, 20 miles west of Tampico.	150 bbl. per day.	Waters-Pierce interests. Have one well brought in and are prospecting this district. Have refinery of 2000 bbl. capacity at Tampico and similar one at Vera Cruz.
International Fuel Oil Co.	Los Esteros.	Nil.	Eaton & McIntosh of Oil Wells Supply Co., Chicago. Doing prospecting work.

and although some is refined the greater part is used as fuel oil. The Huasteca oils are much lighter and of better quality and are to be refined in the Waters-Pierce refinery at Tampico. This refinery has been fitted with the latest appliances, and is much superior to the one at Vera Cruz. The production from the Furber wells and the quality of the oil are as yet unknown. The wells of the Compania de Petroleo del Aguila have been non-productive since the Dos Bocas well was burnt out. The company, however, has just brought in a well at Tanguijo, near Tamiahua, producing light oils, at a small depth; but data as to its probable daily production are not obtainable. The oils from the San Cristobal districts are of low specific gravity, and are refined at Minatitlan, but the production for a long time has not been sufficient to supply the capacity of the refinery, and oils have been shipped from the United States to be refined there. It would appear that these imported oils are chiefly for re-export and foreign trade, and therefore have to pay no import duty; but what proportion of these imported oils have been used for the retail trade in Mexico in competition with the Waters-Pierce company is not ascertainable.

From the above it will be seen that the Mexican oilfields do not supply more than about one-third of the Mexican demands; and that the general trade of crude oil so far obtained has not been good, that from Ebano indeed being a heavy fuel oil. The wells have not been steady producers, excepting those at Ebano; while giving considerable quantities at first, the others dropped off in their output quickly. This seems to have been the case at San Cristobal especially. Further prospecting gives hopes of new wells being discovered of a more persistent nature. About 30 holes are being drilled by the various companies. At the present time the total native supply is, as above stated, about 8500 bbl. per day. The Pearson companies have only a small proportion of this with which to fight the old-established Waters-Pierce Oil Co. which imports oil from the United States. This means that to compete with the latter company for any large portion of the Mexican retail trade, the Pearson companies require to import oils from abroad also.

The cut-rate competition between the Compania de Petroleo del Aguila, controlled by the S. Pearson & Son, and the Waters-Pierce Oil Co. continues apace, with oil selling in Mexico below cost. How long it will continue it is impossible to say. The development of a large supply of native oil would give one or other of the rivals a final advantage.

Electrification of the Rand.

The commission appointed by the Government to enquire into the influence of central electric power schemes upon the welfare of the country and its mines has issued a report. The principal conclusions of the commission may be condensed as follows:

The establishment of large power companies is desirable, if subject to effective control, for the reasons that (1) gold mining will benefit substantially from savings to be effected in the working cost and in capital expenditure, and from the economies resulting from the greater flexibility, adaptability, and cleanliness characteristic of mechanical operations when performed by electric power. (2) The coal industry will not suffer. (3) The character of the traffic on the Central South African Railways (Government) may be affected slightly, but this will be more than compensated by the increasing volume of general business. (4) Agriculture should benefit by the industrial expansion, and other industries may arise as a result of cheap power, such as the manufacture of steel from scrap iron or the production of fertilizers. (5) The demand for white labour will not be reduced; and (6) the "country generally is bound to benefit by the increased revenue from the profits tax and by the incidental expansion which the availability of cheap power must stimulate."

The meaning of the words 'effective control' is indicated by the provisions made in subsequent recommendations. One stipulation appears exacting, namely, that, after 30 years the State has the right to expropriate the undertaking after giving reasonable notice. For the rest, the recommendations are sound. It is urged that the prices charged for power should be reduced automatically from time to time by applying surplus profits to the reduction of prices, after the payment of 10 to 12% on the capital invested in remunerative plant. Power companies should not own or operate coal mines except for the supply of their own needs. The sharing of profits with customers should only be permitted on condition that all customers benefit equally. These rules accurately define the powers of the companies. They will be acceptable to those who desire to see some reasonable government control of great corporations, avoiding the irresponsibility of American trusts on the one hand and the wholesale state socialism in Australia on the other.

TIN MINING IN BOLIVIA

By W. R. RUMBOLD

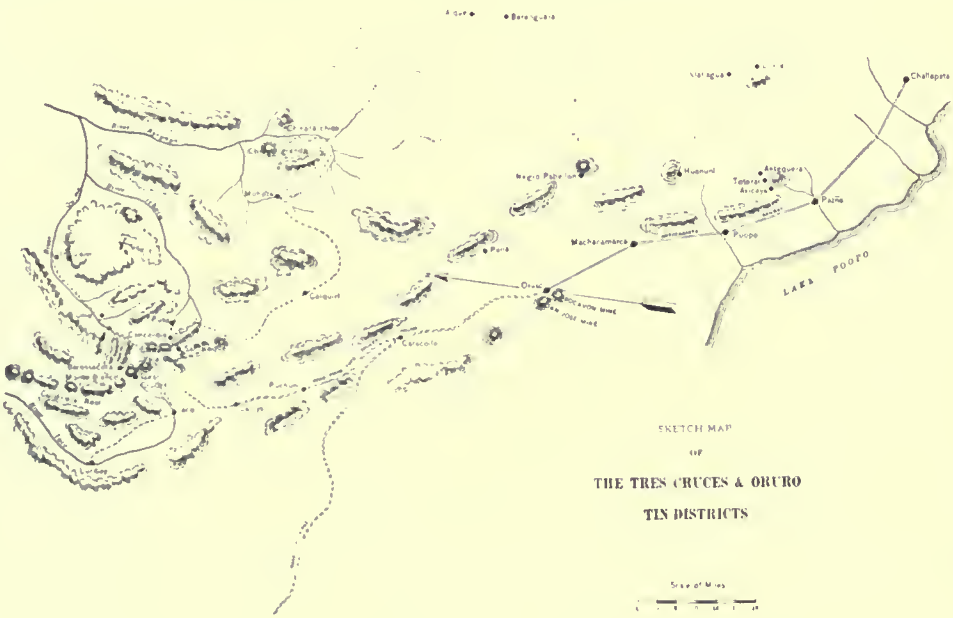
THE regions producing tin are few and far between, and there are many countries where tin has not been found at all. In North America tin is hardly more than a mineralogical curiosity; the tin production of Africa has been insignificant; and without Cornwall, Europe would hardly figure in the statistics.

The tin discoveries of recent years have proved disappointing; both South Africa and Alaska have failed to increase the world's supply of a most useful metal.

Now Northern Nigeria is the subject of optimistic reports, but as yet no definite information either from an economic or geological point of view has been published, and we must reserve our verdict. So it seems that for a little while yet we shall have to depend for our supply on the old producers, the Federated Malay States and Bolivia, not of course forgetting the two famous Dutch islands of Banka and Billiton, and the smaller Cornish and Australian industries.

The Federated Malay States have been marking time for some years, but it must be remembered that Kedah, Kelantan, Trenganu, and Pahang are undeveloped; moreover the extension of the tin deposits into Siam and China have yet to be traced.

The tin deposits of the East, however, are alluvial, the tonnage produced from lode mining being trifling. In passing, I may also note that all big alluvial tin deposits have been derived from the disintegration of millions of tons of rock carrying a minute proportion of tin, and that big alluvial deposits and rich lodes never seem to exist together. I notice that the pioneers in Northern Nigeria claim both the alluvial tin and the "mother lode from which it has been derived." Further facts concerning this unusual combination will be awaited with interest.



SKETCH MAP OF THE TRES CRUCES & ORURO TIN DISTRICTS

After the Federated Malay States and the Dutch East Indies, Bolivia ranks next in importance as a tin-producer. Let us therefore make a rapid examination of the conditions in that country, for rapid examinations are popular in Bolivia, and "the well known mining engineer" does not linger long, frightened perhaps by the high altitude, or is it the high prices asked for the mines? The altitude is certainly abnormal, for Bolivia occupies a high plateau bounded on the east by the main range of the Andes, and nearly all the mines are over 12,000 ft., some even touching 16,000 ft. above the sea. East of the Andes the country falls rapidly to the tropical forests of the Amazon and Paraguay, at present growing rubber, and the scene of operations by a pioneer gold-dredging company. West of the Cordillera Real the country is a bare dry table-land, once the bed of a huge inland sea, of which only lakes Titicaca and Poopó now survive. Here, in the surrounding hills, we find the tin districts of Bolivia. Tin has not been found in large quantity north of La Paz, or south of Chorolque; between these two extremities are the mines, with Oruro and Potosí as the chief centres of the industry.

The little that has been written on the Bolivian tin deposits endeavours to prove that their genesis is quite peculiar to themselves, and unlike the origin usually imputed to tin lodes. This theory, I think, is wrong, and I have tried to disprove it elsewhere.* To put it shortly, I find that the tin deposits of the Oruro and Tres Cruces districts are in Devonian slate, schist, and quartzite, intruded by dikes and bosses of quartz-porphyry, and that tourmaline invariably accompanies the cassiterite; further, that the andesite is merely a lava covering the ancient land surface and is not connected in point of time or origin with the tin deposits.

Perhaps some readers of this article will be astonished to hear that there is a Bolivian mine actually producing 500 tons of tin concentrate (about 60% metal) per month, and that a good deal of this production is merely picked and sacked at the mouth of the mine and is never milled. These riches are found in a lode less than three feet wide traversing a huge boss of quartz-porphyry. Several other lodes are worked in the same 'massif.' The occurrence is however exceptional, the tin being usually found in quartzite-schist.

I have just heard that the Bolivian tin production for 1909 has increased by 4000 tons, and it will increase in spite of numerous adverse conditions, for sooner or later foreign capital will recognize its importance. The capital will either be British or American, but I rather think the latter. America has wanted tin mines for a long time, and wants them badly; the Americans are the biggest consumers of tin in the world, and they have to buy it all at second-hand. They have made several attempts to get a footing in Bolivia, but have always retreated, chiefly, I suppose, on account of the high prices asked by the owners of mines. The trouble is that the owners have based their prices on the past and present production of their mines and not on the ore developed; but one can hardly blame them for asking big prices; they are not anxious to sell, and many of them have started from small beginnings, gradually working their way into profitable enterprises. If they find, as I am afraid they must, that the system of working from hand-to-mouth ends in disaster, they will only blame their bad luck and start again.

As a rule things are run badly; too little development work is done, nor is it done intelligently. Often thousands of dollars are thrown away from bad survey work or from the entire lack of a survey. Few engineers realize that in this age of enlightenment, thousands of quintals (a quintal equals 100 lb.) of tin ore are being transported from the bottom of Bolivian mines on the backs of men and boys. Concentration, too, is primitive, round buddles being the usual method; the sizing and classification is incomplete; usually the ore is ground too fine and the loss in slime is heavy. The casual visitor at once condemns the whole process and wants to 'scrap' all the present plants and erect new ones, but he forgets that in Bolivia people are working under hard conditions as to labour and supplies, and that, after all, a buddle well managed is better than a table badly regulated. Nearly all the tables and vanners that are running are poorly erected and carelessly adjusted. They are not a good advertisement to the makers. It must also not be forgotten that all kinds of supplies and 'spares,' which in a civilized country one is accustomed to obtain almost by return of post, have to be ordered from Europe or America, and many months elapse before their arrival. I once cabled for a mining transit, which was despatched within a week of the reception of the cable only to arrive in Oruro 13 months from the date of my order. At another time I was erecting a small plant for the treatment of tailing, and wishing to put in 2 in. steel shafting could find nothing locally between 1 and 3½ in. for love or money. The choice lay between 2 in. round iron and 3½ in. shafting, with no bearings of any size except 1½ and 3 inches.

Anyone building a new mill in Bolivia must order a liberal supply of 'spares' and on arrival at the mill another order should be forwarded promptly.

Another trouble, typical of the unscientific methods of Bolivia, is the system of book-keeping. The cost, instead of being reckoned

*'The Origin of the Bolivian Tin Deposits' *Economic Geology*, June 1909.

A PROSPECTING PARTY IN THE ANDES.

ON THE BOLIVIAN PLATEAU.
The troubles of a traveller.

on the ton of ore mined or milled, is always calculated on the quintal (100 lb.) of concentrate produced; the cost per quintal naturally varies with the assay-value of the crude ore and is no guide whatever to the economy of the management. It is difficult, from such data, to arrive at the cost per ton of ore milled, but from my own examinations I have come to the conclusion that the best result approaches £3 per ton of ore milled, and the average cost must be about £5 per ton. Then you must remember that added to this is the freight from mine to railway station and thence by way of Antofagasta to Liverpool, as well as the smelting charges, which altogether may be taken at £26 per ton of concentrate. Dolcoath ore mined and put into a Bolivian mill free of cost would not pay.

Power is a most expensive item. Coal costs £8 per ton and the cheapest form of power at present is the suction-gas engine, which costs about 14 cents (Bolivian currency) or 2½d. per horse-power-hour. There is water-power in the Andes, but an installation to transmit say 3000 h.p. 100 miles will cost a large sum for Bolivia, and the capitalist likes a firm guarantee (for the consumption of his power) such as the mine-owner, especially in the present undeveloped condition of his mines, cannot honestly give.

There was a 'boom' a few years ago; several Chileans came up and with the aid of reports, either ignorant or unscrupulous, managed to buy and float a number of Bolivian tin mines on the Chilean market. Owners who had hitherto asked their prices in Bolivianos turned the latter into pounds sterling, not at the current rate of exchange, but by a scale of their own, and not only changed their prices but got them.

J. H. Curle, in a letter to the *Mining and Scientific Press* about two years ago, severely, but I think not unduly, criticized Chilean mining finance and management, especially referring to a Bolivian mine called Llallagua, floated for £420,000 in Chile. Yet in spite of the over-capitalization, bad management, and neglect of development work, the mine has proved so rich that it has paid off a debt of £100,000 accumulated, at about the time of Mr. Curle's visit to Bolivia, and will now perhaps pay dividends to its shareholders.

Labour in Bolivia until recently has been sufficient for the needs of the mining industry, but of late the new railway construction work has competed, and at the present time the supply hardly meets the demand. The miner's daily wage is about 3 bolivianos, or 4s. 6d., but he much prefers contract work. Contracts for driving are generally let at from Bs.30 per metre in soft rock to Bs.70 per metre in fairly hard quartzite-schist.

The miner is only moderately effective: he persists in using an 8-lb. hammer single-handed, and it is safe to say that not one 'white man' in a hundred, much less a Bolivian, can swing such a weapon. He generally uses a handle about six inches long, and it naturally follows that under these conditions there is not much over-head stoping.

The method of entrance and exit to the mine is by an adit, and thence by a sort of winding staircase called a *pique* to the levels below; as the adit is generally made when all the ore above it has been stoped, it follows that the deeper ore has to be raised to the adit-level either by means of shafts and windlasses or on men's backs up the winding staircase.

Machine-drills should be invaluable in Bolivian mines; but, of course, at 12,000 ft. with costly power ordinary air-drills are out of the question. Several forms of electric drills have been tried, but with little success. The electric-air drill seems to be perfectly suited to the conditions, but the cost of power is so great and the difficulty of teaching the Bolivian miner to handle a drill properly so formidable that nothing serious has been accomplished in this direction.

Bolivia is now in the throes of railroad-building. The Viacho-Oruro line is finished, and the Arica-La Paz, Oruro-Cochabamba, Rio Mulato-Potosí, Uyuni-Tupiza lines are in course of construction. These lines will enormously facilitate transport to the present mines, will lead to the opening of hitherto inaccessible districts, and probably also result in new discoveries of mineral.

The various rumours of wars and revolutions do not seem to be serious, and Bolivia is bound sooner or later to find herself an important producer not only of tin and silver, but of copper, gold, and wolfram as well.

Chilean Railways.—The contract for the construction of the southern section of the longitudinal railway in Chile to connect Cabildo and Toledo has been given to Griffiths & Co., Contractors, Limited, a London firm, of which J. Norton Griffiths is head. The price to be paid is £4,250,000, and the length of line is 370 miles. The country is difficult and much excavation will be required. At one point the gradient will be so steep as to require the use of rack locomotives.

THE WORLD'S GOLD PRODUCTION

By T. A. RICKARD

THE statistics of gold production in various regions are now sufficiently complete to warrant an estimate of the world's total output during the past year, and in the accompanying tabulated statement we summarize the data at our disposal. The estimated increase is £3,000,000. In 1909, as in every year since 1904, the Transvaal has been the chief source of the precious metal. The total output of the Rand and its neighbouring districts was worth, in round numbers, £31,000,000, which is about £1,000,000 more than the output for 1908. But with this slight advance in production there was an increase of £758,484 in the dividends, which reached a total of £9,509,766 as compared to £8,751,282 in 1908. Thus the additional profit was nearly equal in amount to the gross increase. The Transvaal output was won by 71 companies, operating 9610 stamps, crushing 1,800,000 tons of ore per month. The average yield was $28\frac{1}{2}$ shillings or $7\frac{1}{8}$ dwt. per ton, and the average cost 19 shillings or $4\frac{3}{4}$ dwt. per ton. In Rhodesia the production has increased slightly, while in West Africa a decrease is recorded. However, it is known that during the latter part of 1909 the developments in several Rhodesian mines presaged a larger output and since then fresh discoveries of some consequence have been made. On the Gold Coast, as West Africa is still sometimes called, the introduction of capital by Rand financial houses led to an enlargement of the scope of operations at several mines, the first consequence of which was to stop milling pending the erection of larger plants, the completion of railways, the exploration of new ground, and other work of a preparatory character, all promising for the future but checking immediate production. Thus the poorer showing of West Africa in 1909 does, in an inverse way, assure a decided growth of the industry in 1910. Madagascar's output increased from 99,616 oz. in 1908 to 122,144 oz. in 1909.

PRODUCTION OF GOLD.

	1909. Ounces	1909. Value	1908. Ounces	1908. Value
Africa:				
Transvaal	7,280,542	£30,925,788	7,052,617	£29,986,469
Rhodesia	617,370	2,623,788	594,359	2,526,007
West Africa	235,972	955,635	297,366	1,186,342
United States	4,800,359	20,460,247	4,659,360	19,802,240
Canada	473,300	2,011,700	476,112	2,024,195
India	510,101	2,167,934	507,937	2,158,736
Australasia:				
West Australia	1,576,405	6,696,112	1,596,090	6,779,763
Victoria	658,200	2,897,340	676,001	2,872,990
Queensland	450,937	1,916,468	461,359	1,960,766
New South Wales	204,709	869,546	224,792	954,854
South Australia	7,000	29,450	9,162	38,540
Tasmania	44,777	190,201	57,085	242,611
New Zealand	472,220	2,006,910	471,520	2,004,925
Russia	1,566,473	6,657,510	1,361,302	5,785,533
Mexico	1,223,600	5,120,000	1,170,850	4,903,800
Other countries	1,799,718	7,638,525	1,610,102	6,983,014
Total	21,921,683	93,167,154	21,226,014	90,210,785

The pound sterling is taken at \$4 85; the ounce of fine gold is worth \$20·67, or £4 4s. $11\frac{1}{2}$d. The pennyweight is roughly equal to a dollar. The Russian *pood* is equal to 36·1128 lb. avoirdupois or 526·645 oz. troy.

Each of the States of the Australian Commonwealth shows a small decrease, but the Dominion of New Zealand exhibits a slight increase. Of the total New Zealand output the great Waihi mine is responsible for 223,240 oz., or about one half. From the 123 dredges at work, chiefly in Otago, a production of £373,818 is recorded during 1909, this being £45,816 less than in 1908. Of Victoria's production, the district of Bendigo yielded 212,034 oz., but the best results came from comparatively shallow workings—an important fact as affecting the future of a locality long famous for its deep mining. In New South Wales the Cobar district did best, yielding 58,047 oz., worth £246,567. The Mt. Boppy is the premier gold mine in this State. To the Queensland output the Mount Morgan mine contributes 152,823 ounces of gold, while that of Western Australia is largely due to three great mines, namely, the Golden Horse-shoe, Great Boulder Proprietary, and Ivanhoe, which together contributed 400,000 ounces. Tasmania exhibits a notable decrease, due largely to the flooding of the Tasmania mine, at Beaconsfield, which produced £92,767 at a slight loss. Tanami, the new goldfield near the western border of South Australia is promising, but it shows no signs of becoming an important source of gold. No new goldfields of importance have been found lately in Australasia and a slow dwindling of production is manifest despite the lowering of the operating cost and the consequent widening of the economic limit.

In the United States the increase is $4,672,200, or nearly a million sterling, placing that country second only to South Africa. Since 1905 the United States has outranked Australasia in the production of gold, and is now well to the front. American statistics, however, are not final, because the difficulty of collecting the returns hinders a close estimate. In Australia and Africa most of the gold is extracted at the mines by wet milling, but in America much of it is derived from ore that is smelted, so that the gold is collected in matte and other intermediate metallurgical products that are transported long distances to the refineries. By reason of these transfers it becomes easy to confuse statistical information. Hence, the Director of the Mint usually makes important corrections in his revised figures, published later in the year. However, it is apparent that the gold-mining industry continues to grow in the United States, particularly in Nevada, Alaska, and California. The Goldfield Consolidated mine (with a production of 330,558 oz., worth $6,832,652) is responsible for most of Nevada's increase, which amounted to $3,219,000, with a total yield of $14,908,000, or £3,073,814, which is more gold than was produced in the halcyon days of the Comstock, between 1876 and 1878. Alaska continues to increase slowly; in 1909 the production was $20,947,600, or $1,088,800 better than in 1908. Of this total $3,500,000 comes from the Treadwell group of mines on Douglas island, and most of the remainder is won from the shallow alluvial deposits of the far North. The Tanana (or Fairbanks) district contributed $5,750,000, and the Seward peninsula (or Nome district) gave $4,150,000. California and Colorado are nearly equal, with $21,271,300 and $21,934,700, respectively, but California gained nearly two million dollars in 1909 while Colorado decreased one million. These differences are due, in the first place, to the growth of dredging, which more than compensated for the decline in vein mining on the Mother Lode in California; while in Colorado the Cripple Creek output is checked pending the completion of the drainage adit, which is to facilitate exploitation in the deep mines. In Colorado the Camp Bird mine produced $2,267,905. In South Dakota the yield was less by $892,300, owing to labour troubles at the Homestake mine, which produces 80% of the total output of the State. Montana and Utah yielded between 3½ and 4 million dollars apiece, chiefly as a by-product from copper ores. It is noteworthy that gold mining in the Southern States continues to diminish in importance, and is now insignificant.

Of the Indian total, no less than 490,329 oz., valued at £2,083,896, is to be credited to the Kolar goldfield, the bulk of the production coming from four mines, namely, the Mysore, Champion Reef, Nundydroog, and Ooregum. These constitute a remarkable group; the deepest workings at 3450 ft. are yielding rich ore, so that continued persistence appears assured to an even greater depth.

The Canadian gold comes mainly from the Yukon, where the Yukon Gold Company, operating the rich ground on the creeks tributary to the Klondyke, is the chief producer with an output (for 1909) of 84,547 oz., worth £359,179. In British Columbia the total output decreased from 287,932 oz. in 1908 to 275,500 oz. in 1909. The two principal placer-mining districts, Cariboo and Cassiar, both showed a decrease, and temporary suspension of work at the Le Roi mine, at Rossland, was another unfavourable factor. Nova Scotia produced 12,600 ounces.

In Mexico the district of El Oro, in the State of Mexico, is the most productive. The big mines are the Dos Estrellas, the El Oro, Esperanza, and the Mexico, the last three being on the same lode and under English control. These four big mines in 1909 treated 922,766 tons of ore for a return of $10,121,175 and a profit of $4,531,290. The total production of the El Oro district is about $11,000,000 per annum, and of this $7,500,000 is gold, the remainder being silver, together with the base metals. Most of the silver-mining districts of Mexico yield gold in the proportion of 5 grammes of gold per kilogram of silver. As the total output of silver is 75,000,000 oz. this by-product of gold amounts to 375,000 ounces.

Europe, fifteen centuries ago, was the chief source of the world's gold; today it ranks last among the continents. Hungary contributes more than half the total output; next to the ancient goldfields of the dual monarchy comes France, which in recent years has yielded a rapidly increasing, but relatively small, quota to the world's gold production. In 1908 France produced £145,000; in 1909 the yield is estimated at £200,000. Four noteworthy gold mines are in operation in France; of these the La Belliere mine, in the department of Maine-et-Loire, in 1909 yielded 29,024 oz. gold, valued at £124,108, from 68,880 tons of ore. Great Britain contributes about £5750 per annum.

The Russian production exhibits a healthy increase, due mainly to the Bodaibinsk district, which includes the mines of the Lenskoie, now controlled by the Lena Goldfields, an English company, which in the year ending June 30, 1909, won £1,348,000 from the washing of 604,000 yards of gravel. In 1908 the Bodaibinsk yielded 364,438 oz., as against 431,849 oz. in 1909. The Blagovestchensk and Irkutsk districts contributed 257,002 and 203,285 oz., respectively, while the Ural production was only 62,100 oz. It is noteworthy that the Russian production of gold is usually credited to Europe, but it is a fact that only the Ural output is won from mines in Europe, the yield of the Empire as a whole being emphatically Asiatic in its geographic distribution.

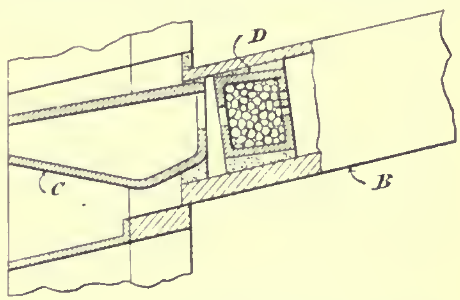
It is noteworthy that the Australian output has dwindled since 1904, while that of the United States has increased steadily; the yield of South Africa has risen rapidly during the last five years; so that in 1909 the output of South Africa (that is, the Transvaal and Rhodesia) amounted to £33,549,576 as against a combined total for Australia (excluding New Zealand) and the United States of £32,971,889. Another interesting comparison is that between the six continental areas, as shown in the annexed table.

Estimates made in January, by others, assumed a small gain in the Canadian output and a big increase in that of the United States, but both of these assumptions proved incorrect. Canada exhibits a slight diminution,

	1909	1908
Europe...........	1,007,275	879,918
Asia...............	11,554,744	10,600,265
Africa.............	34,955,361	33,926,068
North and Central America...	27,610,947	26,748,235
Australasia.......	14,606,027	14,854,449
South America...	3,432,800	3,201,850
Total......	£93,167,154	£90,210,785

namely, £12,495, and the United States an increase of only £658,007. The early estimate of Russian production was also optimistic, for the gain is only £871,977. Mexico yielded £200,000 more than in 1908, and thus balanced the loss in Australasia. On the whole, the statistical position exhibits no startling changes and may be said to confirm the tendencies marked in 1908, no new source of production having been developed. The most interesting features of 1909 were the advance of gold mining in the Bodaibinsk district of Siberia, the revival in France, the developments in Madagascar, and finally, the continued predominance of the Rand.

Brand's Zinc Process.—In our issue of November we gave a précis of a paper on the Brand process for smelting zinc ore in use at Irvine, Scotland. The author of the paper stated that the process was specially adapted for the distillation of zinc ores high in lead and that a filter is used for the purpose of catching



the volatilized lead, but he did not describe the exact nature of the filter. Many such filters have been proposed, so that details are of interest. British Patent 9955 of 1909 granted to C. S. Brand shows that the invention consists of a container charged with refractory material fitted tightly within the mouth of the retort. The accompanying illustration shows the construction and the relative positions of the container (D), condenser (C), and retort (B). The refractory material consists of silicious material such as silica brick or broken retorts.

CONCENTRATION OF SOLUBLE GOLD IN A DUMP

By GEORGE B. BUTTERWORTH

IN the life of most goldfields there comes a time when, owing to improvements in the treatment of ores, attention is paid to the residue or tailing accumulated from early operations. This is exemplified at the present time at Broken Hill and at Kalgoorlie, where the residues on many mines are being treated profitably for a further recovery of their metal contents.

The valuation of such residues is necessarily most important, and this article deals with a specific case in which an unexpected natural factor was made evident during the sampling of a dump at Kalgoorlie, as was subsequently demonstrated by the treatment of the material.

The residues, of which there was 120,000 tons, came from a sulpho-telluride ore of variable grade, after treatment by dry crushing, roasting, sliming, amalgamation, cyanidation, and filter-pressing. A large portion of the residue from the higher grade ore had already received a second treatment. This dump, which was irregular in shape, took the general outline of a rectangle, and had been tipped from trucks in layers until its surface was horizontal from side to side. The depth of 10 ft. at one end gradually increased to 22 ft. at the other. The rough measurement would be 520 ft. long by 410 ft. wide, with an average depth of 16 feet.

The residue, before being discharged from the presses, was subjected to a final fresh-water wash and then dried with compressed air, then it was tipped on the dump to all appearances comparatively dry although containing about 20% of moisture and a trace of cyanide. Owing to the nature of the material, it formed a porous mass. At the time of sampling the whole dump had been standing about an average of two years, the newest portion six months, with alternate wetting and drying during the seasons.

Samples were first taken on the outside. At every 40 ft. a channel was cut one foot deep into the face from top to bottom, and from this channel a sample of about 3 lb. per foot was taken, quartered down to a suitable size, and dried. The channels cut were distinctly across the edges of layers and, although not representing an ideal procedure, were, under the circumstances, representative, and in many cases the faces of the lowest layer were sampled separately and averaged. All averages were computed upon the foot-pennyweight basis. The average value from the 54 samples obtained in this way was 2·833 dwt. per short ton. This assay being higher than the daily records of the residue, it was decided subsequently to confirm the results by boring.

The dump was divided into 50-ft. squares starting 25 ft. from each of two adjoining sides. At each corner holes were put down with a 2 in. augur, yielding about 1·5 lb. per foot. No casing was used, as the material was slightly cemented. These holes were bottomed, and measurements taken for averaging the results.

The average value of the dump obtained from the bore-hole samples was 1·625 dwt. per short ton. To check this a proportionate bulk sample was taken ; it confirmed this value to within one grain. With the exception of three holes, which assayed from 2 to 3 dwt., all the others ranged between 1 and 2 dwt. per ton.

A syndicate, knowing something of the mine's earlier history, obtained permission to sample this heap with a view to purchase. They started sampling on the faces and obtained encouraging assays. These samples and many others from the faces yielded a satisfactory amount of gold by washing in their laboratory, some samples yielding 8 to 10 shillings per ton by this simple treatment. Although the few bore-holes they sunk did not confirm these high values, they decided to purchase, being influenced presumably by the higher values obtained from the faces.

It is not intended to deal with the operations of the syndicate, or the company promoted by it, beyond the fact that after spending a considerable sum of money their operations upon a few thousand tons proved unprofitable, and confirmed the dump-value as being close to 1·625 dwt. per ton.

This, undoubtedly, is a case in which a portion of the gold in the residue was converted into soluble gold in the presence of even such a small quantity of cyanide as remained after the final fresh-water washing, during the air-drying and subsequent handling, until it was buried in the dump. The rain soaking through would then be a solvent and the sun would draw the moisture carrying gold to the outside crust ; this would be deposited by evaporation as a soluble salt of gold.

PRÉCIS OF TECHNOLOGY

Uses of Aluminium.—In *The Metal Industry* (New York) for March, Edward K. Davis, superintendent of the Aluminum Co. of America, Pittsburg, contributes an article on the application of aluminium in the manufacture of plant in which corrosive gases and liquids are used. Aluminium possesses the quality of resisting the corrosive action of many compounds which affect copper, brass, and bronze, for instance various sulphates, nitrates, ammonia, and organic acids. An example is to be found in the sulphite process used in the manufacture of paper. Here the sulphurous acid gas caused the bronze tubes formerly used to deteriorate rapidly, whereas the aluminium tubes now employed may be considered as practically permanent. Another example is found in by-product plant at coke-ovens, where condensing apparatus is used for the purpose of cooling and recovering the ammonia The gaseous ammonia is destructive to copper and its alloys, while the impurities usually accompanying it, namely, sulphuretted hydrogen, and sulphurous and sulphuric acid gases, attack iron. Aluminium is capable of resisting the attacks of both ammonia and the impurities, and is accordingly being used in some of the larger coke-oven plants. Many makers of high-class soaps and candles of which stearic acid is the chief constituent are now using aluminium for all parts of the plant with which the stearic acid comes into contact. Sheets and tubes of copper with a thin lining or covering of aluminium are extensively used in condensers of all kinds; here the aluminium acts in much the same way as the coating of zinc on steel in galvanized iron.

Aluminium tubes from the point of view of strength are not equal to copper tubes. Under the most favourable circumstances the tensile strength of an aluminium tube is 23,000 lb per sq. in., compared with 36,800 lb. per sq. in. with a copper tube. For the purposes indicated by the author, the relative conductivity of heat is usually of more importance than the strength. Copper is the best conductor and aluminium comes next, being superior in this characteristic to steel or lead. The comparison here noted refers to metal with bright surfaces; immediately the surface becomes coated with corroded metal or with a settlement of matter deposited from the gases or liquid with which it is in contact, the question of conductivity becomes entirely different and depends chiefly on the resistance of the coating. In this way it is seen that the preservation of a bright surface by the aluminium not being attacked gives this metal an advantage over copper from the point of view of efficiency in the transference of heat as well as making the plant last longer.

Causes of Ore-Shoots. In *Economic Geology* for March, the conditions influencing the distribution of ore in lodes is discussed by R. A. F. Penrose, Jr., in an article of authoritative value. While the origin of orebodies is closely linked to that of their distribution, Mr. Penrose has endeavoured to confine himself to an elucidation of the causes that lead to those concentrations of mineral constituting rich ore; in other words, he has an eye to the economic, rather than the academic, aspect of the subject. He recognizes the diversity of factors influencing the deposition and concentration of ore, and the consequent difficulty of selecting the influence most potent. But at the outset he endeavours to distinguish between the influences that are favourable and those that are unfavourable to enrichment Magmatic segregation is only touched upon, with a passing recognition of the importance of this young theory. Coming to orebodies in fissures, Mr. Penrose draws attention to the fact that if they be due to hydrothermal action, as is usually supposed, it is not remarkable that they vary in their metallic contents, for the thermal springs of the present day exhibit marked differences in the composition of the waters issuing from neighbouring vents. The Anna Lee, at Cripple Creek, the Oroya Brownhill, at Kalgoorlie, and the Silver King, in Arizona, are instanced as examples of chimney-like masses of ore resembling the filling of a thermal vent. Of course, the old Bassick mine, in Colorado, is quoted, for this is a remarkable and authenticated example of this type of ore deposit. Analogous are the Etta tin deposit, in South Dakota, and the Premier diamond pipe, in the Transvaal. The mechanical features due to obstructions in fissures, to walls pressed together, to curvature and faulting, to cavernous openings, to horses of included country, and other details affecting the movement of the solutions that deposited the ore, are passed in review, with citation of illustrative examples. The author shows personal acquaintance with the subject in its widest geographical application. To this is added an intimate knowledge of recent literature, as is proved by copious and accurate foot-notes, themselves of undoubted value to the student. Next the influence of the wall-rock is discussed, with special reference to Cripple Creek, which Mr. Penrose examined officially for the U.S. Geological Survey. The localization of ore in fissures where they traverse limestone is explained by reference to the chemistry of metasomatism, the calcium carbonate interchanging with ore-bearing solutions and serving to intensify the solvent action of the mineralizing waters. Of this agency it is easy to quote numerous examples, notably Tintic in Utah, Aspen in Colorado, and the Sierra Mojada in Mexico. However, the interplay of agencies in nature is such as to forbid fixity of conditions; the relation between erosion at surface and deep-seated thermal changes is ever shifting; the ore deposit is undergoing attack from above and below. The author devotes a few pages to the superficial alteration of ore, analogous to the surface decay of rocks, and elucidates the facts to which he drew attention so usefully many years ago. In summarizing his conclusions Mr. Penrose says: "Probably the most important and generally observed influences producing ore-shoots are those of the wall-rock, of intersecting fissures, and of local emanations of ore-bearing solutions."

Thomas-Gilchrist Process.—On the occasion of the 30th anniversary of the first operation with the basic converter, *Stahl und Eisen* requested the German engineers still alive who had taken part in the development of the process to prepare historical notices. Thereupon J Massenez, formerly the director of the Horder Bergwerks und Huttenverein wrote that at the spring meeting of the Iron and Steel Institute in 1878, Lowthian Bell caused a conference to be held on his (Mr. Bell's) process of dephosphorization of pig iron, and in the discussion Sydney Gilchrist Thomas indicated briefly and for the first time, that he had succeeded in effecting complete dephosphorization by the Bessemer process. Mr. Bell said he would regard as a benefactor of humanity anyone who might succeed better and more economically than he himself had done in dephosphorizing iron. The remainder of the assembled members seemed to give no special attention to these statements. The autumn meeting of 1878 was held in Paris when Sydney G. Thomas and his cousin Percy C. Gilchrist presented a paper on their invention the discussion of which was deferred to the meeting the following spring. Meantime Thomas was able to experiment with a large converter in cooperation with Windsor Richards, a director of Bolckow Vaughan & Co.'s works at Middlesbrough. On April 4, 1879, Thomas & Richards in presence of a small number of distinguished English metallurgists, successfully executed an operation with the basic converter on Cleveland pig. Thereupon Massenez sought to acquire the patent for Germany and Luxemburg but was forestalled by G. Pastor, director of the Rhenish Steel Works of Ruhrort, where the process had already been put into use. Eventually the two firms agreed to share the patent rights for Germany and Luxemburg. Specially memorable was the meeting of the Iron and Steel Institute at which were present Schneider from Creusot, Pourcel from Terrenoire, and Professor Jordan and A. Carnegie from Pittsburg. On this occasion a conference was held at which Thomas described the progress he had made and the results to date. He developed the idea that the dephosphorization by the Bessemer converter is hindered by the silicous lining with its acid slag and showed that the problem was to find a basic lining. His experiments had indicated the necessity for some basic addition to protect the lining and he adopted a mixture of lime and oxide of iron for this purpose. The slag he thought should contain at least 20% of silica and more than 30% of lime and magnesia. In his experiments with Windsor Richards he had successfully used bricks of dolomite. Some days after the meeting, the English as well as the foreign members of the Institute were present at an operation with an 8-ton charge and immediately thereupon Massenez negotiated with Thomas for the monopoly of the patent for Austria-Hungary, and henceforth the process went into full industrial operation, all doubt as to its superior technical value having ceased. In Germany from 1900 to 1909 the output of Siemens-Martin steel remained about 147,000 tons annually. In 1907 the output "sur sole basique" rose from 2 to 4 million tons, whereas the output by basic converter rose from 4,141,000 to 7,212,000 tons, and the production by Bessemer converter remained at 400,000 tons. From the outset Thomas himself had remarked that the slag so rich in phosphoric acid would be an excellent fertilizer, but it required time to determine the combination under which the phosphoric acid existed. There is now in Germany an association of factories of which the annual output exceeds the half of the world's entire consumption which in 1908 attained 2,600,000 tons.

Iron Ore in Swedish Lapland.—In *Annales des Mines*, P. Nicou gives an account of the history and present position of the iron ore industry of Swedish Lapland. The production is shown in the following table:

	Yearly Output
1833 to 1840	235,000 tons
1886 to 1890	932,470 tons
1891 to 1895	1,519,325 tons
1907	4,480,070 tons

This rapid increase during recent years is coincident with the completion of the railway to Narvik (Norway), where navigation is free from ice. These mines furnish more than 60 per cent of the total output of Sweden. The older deposits of Sweden are principally devoted to home requirements. They have an annual output amounting to about 20% of the total of the kingdom Lapland included. The export of ore from Sweden which in 1892 was 320,071 tons, totalled 3,521,717 in 1907. Of this the shipments via Narvik amounted to 1,414,800 tons. Gellivara, the principal mining centre in Swedish Lapland is 204 km. from Lulea and 268 from Narvik. The ore is found in two series of masses or lenses whose collective area is some 25,000 sq. m. The containing rock is gneissic. The ore is won partly by open-cast and partly by mining. The shafts for the latter operations have a section of 6 m. by 5 m., they are divided into three compartments, and are equipped with electric winders of 60 to 70 h.p. The drainage is effected by means of electric pumps having a capacity of 400 to 600 lit. per min. During 1907 about 1500 people were engaged at Gellivara.

The ore masses consist of magnetite with a little mixture of hematite the latter sometimes occurring in veins in the midst of the mass. The hematite is less compact than the magnetite. Apatite is disseminated in the mass and there is a variable content of phosphorus. Sorting gives 56 to 59% of the extracted mass as marketable output. The ore is rich in iron and contains little of sulphur, silica, and lime. The cost of production is on an average 2·78fr. per ton on the railway truck.

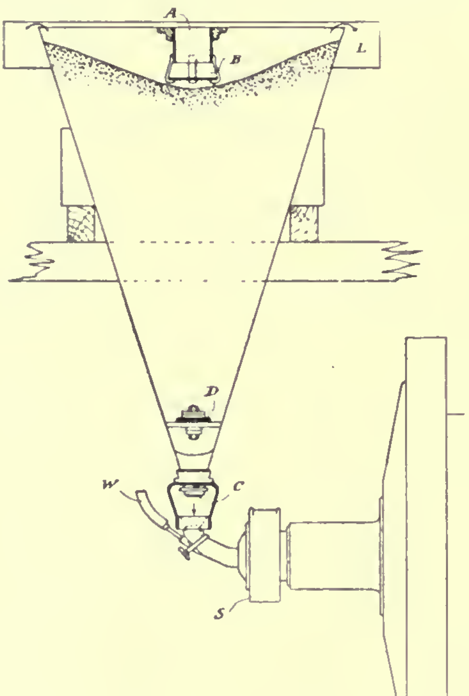
Experience has shown that the ore may be classed in four divisions.

	1	2	3	4
Phosphorus content	0·025	0·293	0·536	1·244%
Iron content	69·23	67·03	65·91	62·47
Percentage of total output	4	12 to 18	25 to 35	40 to 50

Reckoning only on a depth of 100 m. below the actual excavations these deposits are supposed to represent a tonnage of 51 millions of marketable ore.

The Kirunavarra deposit 168 miles from Narvik and 305 miles from Lulea, was discovered in 1736. It yielded only about 20,000 tons in 1901 but since the completion of the railway to Narvik in 1902, its annual market consignments have risen to 1½ million tons. The ore occurring in one body is seen cropping out in the porphyritic hill ridges. The producing capacity of this deposit is supposed to be 700 million tons. The excavation is open-cast worked in benches or stopes of 12 to 20 m. The broken ore yields over 80% of marketable ore costing 1·67fr. per ton. The ore in this case is compact magnetite that has a metallic fracture, and is intimately mixed with apatite; it is calcareous and gives a small proportion of smalls. For 1906 the average in metallic iron was 62·8 and 1·585% phosphorus; 68% of the total marketable output is ore containing 0·75 to 2·50% of phosphorus and only 16·6% of it contains less than 0·05% phosphorus. As in the case of Gellivara the power is supplied from a central generating station in which English coal is used. This Lapland ore is shipped to Germany (2,550,000 tons) and to Britain (383,000 tons in 1907). Though the ore is rich in iron it requires copious supplies of lime for fluxing and the unevenness in its content in phosphorus implies furnace complications The prices paid for this ore by the more distant of the consumers are low.

Caldecott's Classifying Cone.—The classifying cone introduced by W. A. Caldecott was described eighteen months ago by the inventor in papers read before the South African Association of Engineers and the Chemical, Metallurgical, and Mining Society of South Africa. As it has attracted much attention and as further papers containing results of experience have recently been read, it is desirable to reproduce herewith a drawing explaining its action. The objects of the cone are to remove as much as possible of the finer particles from the stamp-mill tailing before sending it to the tube-mills for re-grinding, to reduce the amount of water in the tube-mill pulp, to regulate automatically the consistency of the material fed to the tube-mills, and to do this with the simplest and most compact apparatus. The essence of the invention is the provision near the bottom of the cone of an obstructing disc, or 'diaphragm' (D). This disc is supported on radial arms fixed to the interior of the cone, and an annular space is left between the disc and the sides of the cone to allow of the passage of the thickened pulp. The presence of this 'diaphragm' prevents the formation of the usual vertical channel down which thinner pulp would flow leaving the thicker packed at the sides of the cone; also by relieving the pressure of the material, it prevents choking at the discharge-valve (C). In this way a continuous and homogeneous flow is insured, with the use of the smallest possible amount of water. The tailing from the stamp-mill enters at the centre (A) and the flow is spread horizontally to the periphery by the baffle (B). The finest particles, not requiring re-grinding, flow to the circular launder (L).



Classifying Cone

The surface of settled solids is concave, the level of the edges being higher than the centre, and the coarser grains settle nearer the centre than the finer. If the ratio of water to solid in the pulp decreases, then some of the finest particles will not pass into the launder but will accumulate round the edge of the cone; as the surface of the solids is raised in this way the velocity of the current over the periphery will be gradually increased and eventually will be strong enough to bring the classification to its normal point. Conversely, if the ratio of water to solid be increased, much of the material accumulated round the periphery will be removed, and the area over which the water flows will be enlarged, thus reducing the speed of flow, and the normal classification will be restored. As regards the delivery of the thickened pulp into the tube-mill, the diagram shows that on leaving the cone through the valve (C) it falls into the tube-mill inlet where a stream of water joins it through the valve (W).

G. O. Smart, in a paper published in the *Monthly Journal* of the Chemical, Metallurgical, and Mining Society of South Africa for February, gives the results obtained by the cones at the Simmer & Jack, and compares them with those obtained when using spitzlutten and dewaterers. These results are shown in the accompanying table. The first column relates to a week's run at the beginning of 1908 when four of the tube-mills had the old equipment and two had the cones, and the second column to a week's run at the beginning of 1909 when all six tube-mills had the cones.

		With Spitzlutten	With Diaphragm Cones
Tons milled		18,208	17,934
Analysis of tube-mill pulp	+ 60	61·8	67·1
	+ 90	22·3	20·7
	− 90	15·9	12·2
Analysis of tube-mill tailing	+ 60	43·8	45·2
	+ 90	11·8	11·7
	− 90	44·3	43·1
Analysis of pulp delivered to cyanide plant	+ 60	10·9	7·4
	+ 90	16·0	15·9
	− 90	73·1	76·7
Relative internal capacity of tube-mills		100	102·5
Tons minus 90 per tube-mill per 24 hours		115·2	126·5
Relative tons minus 90 per unit of tube-mill capacity		100	107·3

Naturally these results are comparative rather than exact in their indications of the relative efficiencies of the two systems, owing to the fact that a year ago only two-thirds of the plant was being run on the old system; the actual results would consequently be still more in favour of the 'diaphragm' cones. It will however be seen from the figures given that the amount of minus 90 product per tube-mill per day was raised by 11·3 tons. This is due to the better separation in the classifiers of the coarser particles requiring re-grinding and to the thicker and steadier feed to the tube-mills. The low percentage of minus 90 entering the tube-mills from the 'diaphragm' cones is noteworthy, as also is the reduction of the plus 60 in the pulp sent to the cyanide plant. These advantages are obtained through the greater efficiency of the 'diaphragm' cone. There are also the other advantages that the cones are simpler, cheaper, and less bulky plant, and that less labour and attention are required by them.

We would also draw attention to the article by Walter Neal in the *Mining and Scientific Press* for April 2, describing the working of this cone at the Dos Estrellas mine, Mexico.

Electric Copper Smelting.—Some laboratory experiments carried out under the direction of Dr. Borchers at Aachen, are described by W. Wilkow in the February issue of *Metallurgie*. The ore used was highly silicious containing Cu., 8·2%; SiO_2, 54·8%; CaO, 12·3%; S, 2·85%, and attempts were made to melt it direct. A viscous slag resulted which did not allow the copper to collect, but the addition of iron scale in the proportion of 0·72 kg. per 12 kg. of ore gave a good slag and almost all the copper collected as a matte at the bottom of the furnace. This matte was made up of layers of varying composition but the mean copper content was 60 to 70% while the slag contained 0·15% Cu. For the small size of furnace the power consumed corresponded to 4·9 horse-power-years per ton of copper as matte, but the author gives it as his opinion that a furnace consuming 500 kilowatts would produce the same amount for an expenditure of 1·2 h.p.-years. The treatment of this matte can now follow the ordinary processes or it can be mixed with roasted matte and melted by electrical heating at a cost of 1·4 horse-power-years for a small furnace, a total power of 6·3 h.p.-years. The raw copper resulting from this procedure contained 92% Cu, 3% Fe, and 1% sulphur. The simplicity of this method is almost ideal and the results obtained point to the probability that this process will find an application on a commercial scale.

The subject of refining this raw copper is considered by G. von Lauschenplat in the same periodical. As a preliminary the theory of copper-refining was first examined, with the result that evidence was discovered indicating the important part played by Fe_2O_3 in the slag in oxidizing the impurities and so assisting the Cu_2O dissolved in the copper. In the experimental furnace the slag, consisting of a mixture with the approximate composition of CuO, Fe_2O_3, was first melted and the molten copper was poured through this oxidizing bath. The duration of this refining process was on an average about two minutes. Under these conditions practically all the iron and sulphur are removed, about half the lead remains and the proportion of arsenic is unaffected. The loss of copper is small in comparison to that taking place in the reverberatory furnace, but means will have to be devised to eliminate a larger proportion of arsenic.

Aluminium Conductors.—Another interesting article relating to new applications of aluminium is published in *The Engineer* for May 13. The use of aluminium for electrical conductors has made greater headway in America and Continental countries than in England, the chief reason for the backwardness in this country being the severity of the Board of Trade regulations as regards factors of safety. Aluminium wire can now be made commercially with a conductivity of 63 as compared with 100 for annealed copper wire of equal cross-section—an increase of three points over the figure usually taken in engineering calculations, namely 60%. These are the relative conductivities at 60°F., and it is interesting to note that with an increase in the heat the resistance increases less with aluminium than with copper. The conductivity of aluminium falls when impurities are present; for instance, a wire made of metal 99·6% pure may have a 64% conductivity and one 99% pure may have a conductivity of only 61%. There is a disadvantage associated with aluminium not mentioned by *The Engineer*, namely, the greater cross-section required to transmit a given power. The greater area exposed to wind and snow by the aluminium wire is a consideration not to be overlooked. On the other hand, the lightness of an aluminium conductor compared with one of copper, to transmit the same power, is of advantage in handling and allows the use of less massive supports. Another advantage is that the aluminium conductor, having a greater superficial area, is kept cooler by radiation.

As already mentioned, transmission-wires made of aluminium are seldom if ever used in this country, but in the generating plant the metal has many applications. For instance, generators are connected by this means to the switch-boards, and batteries are connected to the station bus-bars. The joining of aluminium rods and wire has always been a difficult question. Though many solders have been invented, the British Aluminium Co., the only producer in Great Britain, does not recommend the use of any of them. For joining round rods the plan is to hold them a millimetre or so apart and partly to surround them with firebrick; the flame of a powerful blow-lamp is directed upon the ends until the metal begins to flow, when end pressure is brought to bear. As soon as the metal has been forced out all round the joint the blow-lamp is removed and the pressure is maintained until the joint has set. The extruded metal is then cut away and the joint trimmed. The success of this method depends on the rods being held firmly in line and the pressure being exerted evenly. *The Engineer* also describes mechanical methods of joining aluminium and copper conductors. The important point in connection with these joints is that no damp or acid must be allowed to get to them, as electrolytic action would then be set up. The joints have therefore to be wound with waterproof binding, and covered with suitable paint.

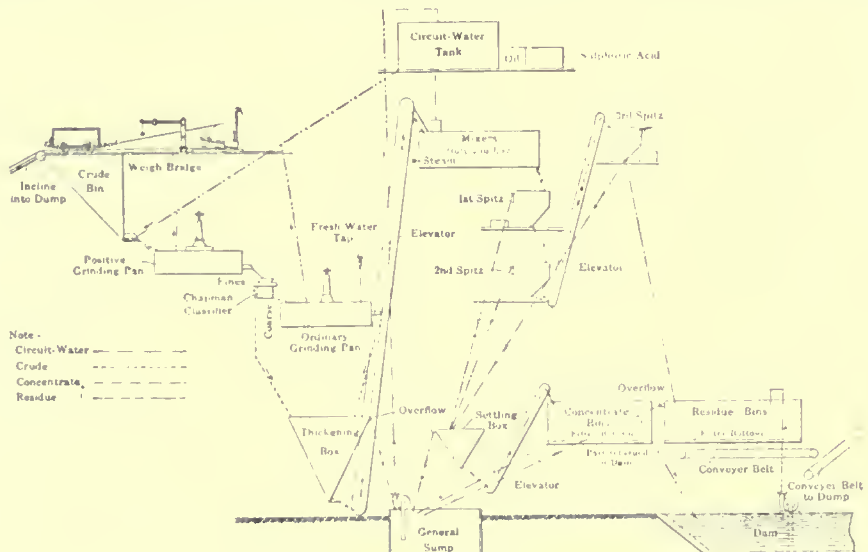
Iron Ores of the Transvaal.—The *South African Mining Journal* for April 23 and 30 publishes the text of F. W. Harbord's report to the Transvaal Government on the iron ores of that country and the possibility of establishing a local iron and steel industry. We discuss Mr. Harbord's general conclusions in our editorial pages and confine this abstract to his account of the ore deposits. These are large and extensive; they may be divided into three classes: (1) titaniferous, (2) magnetic quartzite, and (3) ordinary hematite. The titaniferous ore is found in the district of Onderstepoort, north of Pretoria. The beds outcrop in many places, with a strike east and west and a dip steeply north. Farther east near Kafferkraal, the beds form the surface and are practically horizontal. Little prospecting has been done and the thickness of the deposits has not been accurately ascertained, though such pits as have been sunk do not disclose any great thickness. More prospecting is required. Ore can be obtained by quarrying the outcrops, but for continuous supplies underground mining would be necessary, and until large reserves are obtained in this way it would be inadvisable to start smelting. Samples from the outcrop show 45 to 47% iron, and 13 to 19% titanium oxide, with a little silica. The titanium content is high and at the present time similar ores in other parts of the world are rarely utilized. It may be prejudice or wrong treatment that makes such ore unpopular, but it is obviously bad policy to start an iron industry depending on no other supply than that at Onderstepoort.

The magnetic quartzite deposits are found on the Timeball Hill range near Pretoria, and in the Airlie district. At Timeball Hill, there are two seams one 14 to 15 ft. thick and the other 6 ft. thick, separated by 100 ft. of shale. The beds are faulted and the dip varies. The irregularity of the surface, frequent valleys dividing the range of hills at right angles to the strike, would make it difficult to mine continuously on a large scale. The ore contains 45 to 47% iron, but, as its name implies, the silica content is high, averaging 24%. The phosphorus varies, but the average would be sufficient to give the pig iron 0·3 to 0·45%. The silica would cause expense in smelting and the phosphorus would make the adoption of the basic process obligatory. At Airlie, there are two deposits one on each side of the river; each consists of two beds of magnetic quartzite, the upper 7 ft. thick and the lower 6 ft. thick, the two being 70 ft. apart. The constitution is similar to that of the deposit at Timeball Hill. The dip is gentle and the horizontal surface exposed covers 200 acres. The deposits could be worked by open-cut and cheaply, and the proximity of the railway would facilitate transport.

The hematite deposits are found at Pullenshoop and

Boschmanskop. They are situated on the high veldt 22 to 27 miles southeast of Middelburg. The outcrop has been prospected by means of pits 6 or 8 ft. deep which show that the ore varies in thickness and constitution. At the top magnetite is found, and below this a fairly good quality of hematite, which passes gradually into a hematite shale. The hematite is rich in iron and low in silica and the shale contains as much as 57% iron and only 11% silica. As yet the extent of these deposits is not great and further development will be required before their commercial value is ascertained. If these deposits and the magnetic quartzites at Airlie and Timeball Hill were proved to be extensive, the best policy would be to mix the two so as to reduce the average silica content.

Minerals Separation Process.—The flotation plant belonging to Minerals Separation, Limited, at work on the accumulated tailing at the Central mine, owned by the Sulphide Corporation, at Broken Hill, is described in an article by Theodore J. Hoover in the *Engineering and Mining Journal* for April 30. This plant has been working for two years and its capacity has gradually been raised from 550 to 750 tons per day. The tailing is delivered from the bins to Chapman classifiers, from which the underflow goes to eight 8 ft. 115°F. Fifteen pounds of sulphuric acid per ton of ore is run into the first compartment and 1 lb. of oil per ton into the second compartment. The agitators churn the pulp and so introduce air into it. On emerging from the mixers by openings a foot above the floor of the last compartments, the froth carries the entangled sulphides to the top. The pulp passes along a flume and is delivered to spitz-boxes. Here most of the froth is discharged over the lip of each box and the remainder of the pulp escapes through holes near the bottom. The underflow is sent through two other series of successive spitz-boxes, where further amounts of froth are skimmed off. Subsequently the concentrates from the several boxes are sent to a collecting-box in which baffles are fixed in such a way as to submerge the froth repeatedly, so removing the air and allowing the sulphides to settle Subsequently the sulphides are delivered to bins, which have a porous bottom for the removal of moisture. The water from the thickening-tanks, settling-boxes, and bins is sent back to the distributing centre, so that the slime contained therein may have further opportunity of concentration. The water in the final tailing is also carefully recovered for the reason that water is costly at Broken Hill, the price being 5s. per 1000 gal. The



FLOW-SHEET OF MINERALS SEPARATION PROCESS.

wheeler pans for re-grinding. The discharge from these passes into classifiers and the coarser particles are sent to four other grinding pans. The screen-analysis of the pulp delivered to the flotation plant shows that 26% passes through 0·0025-in. aperture and most of the remainder through an aperture of 0·009 in. This pulp is first thickened in settling-tanks to a consistency of 1 part solid to 3 parts water and then delivered to the mixers, where oil and acid are added and the mixture beaten into a froth. The mixers each consist of a box divided into a series of compartments, 3 by 3 ft. and 5 ft. deep, lined with hardwood. These compartments communicate with each other near the bottom of the dividing partitions, and in each there is an agitator revolving at 220 r.p.m. The pulp is fed into the end compartment, and steam is introduced concurrently in order to raise the temperature of the pulp to average loss of water by evaporation and seepage is 100 gal. per ton of material treated.

Three reasons are given for heating the pulp ; first, the heat thins the oil and so makes it adhere more easily to the sulphides ; second, it dissociates the air absorbed in the water and makes it available for the production of froth ; and third, it expands the entangled air and gives the bubbles a greater buoying effect. The author states that the higher the proportion of slime the better the extraction and that the presence of suspended solids in the water up to 4000 gr. per gal. has the beneficial effect of settling the gangue-slime.

During the two years of operation about 400,000 tons of zinc tailing was treated. The average assay was 20% zinc, 6% lead, and 7 oz. silver. The average assay of the concentrate was 47% zinc, 10% lead, and 14 oz. silver ; and the percentages of extraction were

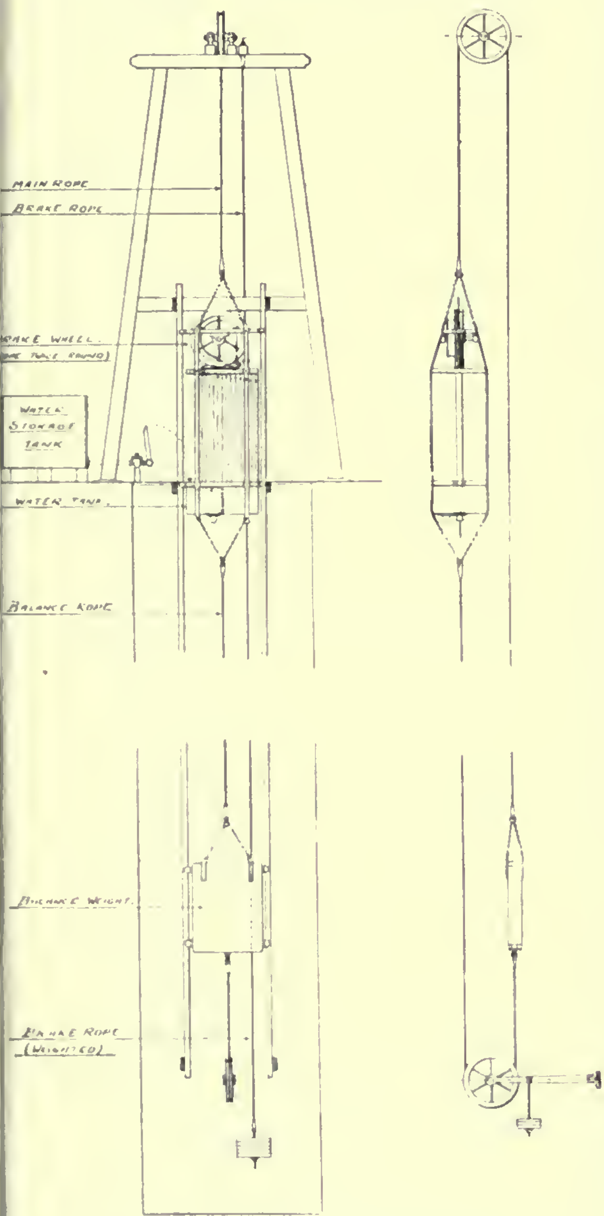
85, 70, and 75, respectively. These figures were taken on the actual contents of the metals, and not on the metals in the sulphides. It must be remembered that in the dumps some of the sulphides have been weathered to sulphates and oxides; probably from 5 to 10% having been altered in this way, and such compounds are, of course, not amenable to the flotation process. The costs of treatment are given as follows: tramming from the dump to the crushers 6½d. per ton, crushing 1s. 8½d., concentration and disposal of products 5s. 5d., a total of 7s. 7d. per ton of zinc tailing. There is no inventor's royalty to pay, as the operating company owns the patents. The amount of horse-power required for the grinding, agitation, etc., is 250. The total cost of erection of this plant was £25,500.

Electric Furnaces for Non-Ferrous Metals.—Joseph W. Richards, professor at Lehigh University and controller of the editorial department of *Metallurgical and Chemical Engineering*, gives a most interesting and suggestive paper in the May issue of that paper on the possible applications of the electric furnace to non-ferrous metallurgy. The iron and steel industries are gigantic compared with those of copper and other non-ferrous metals and hold out greater prospects of reward to the inventors, so no surprise need be expressed that as yet the application of the electric furnace to non-ferrous metals lags behind. Mr. Richards' article is therefore of timely interest and goes to show that it is not for want of applicability that the electric current has been so little used in the metallurgy of the non-ferrous metals. The furnace operations of non-ferrous metals include a great variety of processes. The principal ones are: (1) Melting for refining and casting; (2) melting to form alloys; (3) roasting sulphides and arsenides; (4) smelting to produce matte, that is, concentration by fusion; (5) reducing metal from ore or partly roasted ore; (6) reducing metal from ore or partly roasted ore by distillation. Under the first heading the author points out that non-ferrous metals, being valuable and easily injured by furnace-gases, are usually melted in pots, crucibles, and muffles. But nothing could be cleaner than melting by electric current; for instance, the melting of gold or silver in an induction furnace would avoid the use of fuel and so would produce no ash; no reagent would contaminate the metal, no metallic vapour would be carried away by the stream of hot gas, and the temperature could be regulated to a nicety. The same argument holds good in connection with copper, zinc, magnesium, platinum, etc. Under the second heading the author reminds us that the manufacture of alloys as at present conducted is surrounded with all sorts of difficulties and drawbacks. The contact of hot gases with the mixture of metals causes a deterioration of quality and makes the constitution of the alloys uncertain, besides volatilizing much of the metal. Consequently the melting has to be done in closed crucibles, in small quantities, and with the resultant disadvantages of high fuel-consumption and high cost of wear and tear. The advantages offered by the electric furnace are that several tons of alloy can be made at a time with a uniform composition and without oxidation. (3) The application of the current to the roasting of sulphide and arsenide ores may be advantageous when water-power is cheap and fuel dear, and it will be specially useful when a dead roast is required. (4) The same conditions of cheap water-power would also govern its application to the production of matte in a blast-furnace or reverberatory. It would in this case have the additional advantage that the air introduced at the tuyeres could be used solely for obtaining the required amount of oxidation of the charge instead of at present being used both for oxidation of the charge and the consumption of the fuel. The operations of heating and oxidation could then be adjusted more exactly and they would not interfere with each other. Naturally, if the charge contains sufficient heat in itself, as in pyrite smelting, electricity has no application.

The operations in the fifth class consist of the production of metal from either roasted or raw ore mixed with gangue, flux, and reducing agent. The charge may be heated by fuel mixed with it, as in blast-furnaces, or by fuel burned in a separate place, as in reverberatories. In the latter case sufficient fuel is mixed with the charge to reduce the metallic oxides, and the mixture is heated by gases impinging upon it. The efficiency of this method of heating is low, not more than 25% of the heat being usefully applied; and the volatilization of metal is a source of annoyance and loss. The use of the electric current for heating would be advantageous whenever the cost of power was relatively less than that of coal, an economic condition which would probably be found to exist in many metallurgical and mining centres. The volume of gas coming away would be much less than when the heating is done by fuel, so that loss by volatilization would be greatly diminished. Reduction in the blast-furnace will be simplified in these ways by the use of the current, but there are also other advantages, namely, that the high temperature in the region of the tuyeres will be avoided and the temperature throughout the furnace easily regulated, so that the heat will be even and not unnecessarily high.

(6) Here the advantage of the electric current is perhaps the most obvious of all. The reduction of zinc ores is one of the difficult and least economical of processes. The reaction cannot be done at all in the ordinary furnace where the fuel for heating is mixed with the charge or brought into contact with it by means of gases. It is only possible to carry on the reduction in sealed retorts, introducing the heat through their walls. Such a method of heating is costly because the walls are bad conductors. Electrical heating could be done by inducing the current inside the retort. At the present time there are more chemists and metallurgists working in this than in any other division of the electro-metallurgy of the non-ferrous metals. Though the problem is not a simple one, there is every reason to suppose that it will be solved satisfactorily in the near future. When the electric zinc-furnace has arrived, many alterations in the distribution of zinc-smelters will be made. For instance, at the present time the zinc ores of Italy are exported for treatment owing to scarcity of fuel locally; on the other hand the country abounds in water-power and eventually the reduction will be done at home.

Self-Acting Mine Cage.—At a meeting of the North of England branch of the National Association of Colliery Managers, held on May 7, W. C. Blackett read a paper describing a self-acting cage the motion of which is controlled by the passenger. This is in use at the Nettlesworth colliery in the county of Durham. A few years ago electric pumps were adopted instead of the former installation of steam-driven pumps, and they are placed 240 ft. down one of the shafts. The new cage was adopted for the purpose of enabling the pump attendant to go down and up without assistance, so appreciably saving the cost of labour. As will be seen from the accompanying illustration, the cage is suspended by a rope passing over a pulley in the head-frame. At the other end of the rope is a balance-weight. The bottoms of the cage and balance-weight are connected by a tail-rope which passes under a pulley arranged in the manner shown. Ordinarily the balance-weight is heavier than the cage, which therefore is naturally at the head of the shaft. The lower part of the cage consists of a tank which can be filled with water from a storage tank when it is desired to make the cage heavier than the balance-weight and so enable the man to descend. The cage tank has a valve which



can be opened so as to discharge the water when the man wishes to come to the surface. A brake apparatus is arranged in such a way that the motion of the cage up or down can be controlled by the passenger from within the cage. A rope is attached to the head-frame, and is passed twice round a pulley fixed to the frame of the cage. The other end passes through a pipe in the cage and hangs down the shaft; at the bottom it carries a suitable weight. A brake wheel is attached to the pulley above the cage, and levers actuated within the cage are connected with the brake so as to control the motion of the cage up and down. Similar cages are in use elsewhere, but their braking is invariably done at the head of the shaft by another man. It is the fact that the braking is done by the occupant of the cage that makes this device of interest. We have to thank *The Iron and Coal Trades Review* for the illustration.

The cage measures 5 ft. by 4 ft. by 2 ft. 6 in. and the tank is 1 ft. 8 in. deep with a capacity of 112 gal. or 10 cwt.; the weight of the cage empty is 14 cwt. and full 24 cwt. and the balance-weight is 20 cwt. The main and tail ropes are ¾ in. diam. and the brake rope ½ in. diam. The maximum load is the weight of three men, but by adding to the balance weight or by increasing the turns of the brake rope over the pulley on the cage, the load could be increased to the safety limit of the ropes. As a matter of fact the apparatus is not used for carrying big weights because a horse-winch is available for this purpose. One advantage of the arrangement of the brake-rope is that the cage has two ropes capable of supporting it in case of mishap.

Screens.—At the meeting of the Institution of Mining and Metallurgy held on May 26 two papers were read, one by Theodore J. Hoover and the other by H. Stadler, discussing the various systems of screens, used or recommended, for separating crushed ore into a series of sizes. The proposition made by both authors is that the ratio of the grains shall be reckoned in volume and that the ratio of each size to the next shall be one-half. That is, the ratio of the linear dimensions of each size to the next shall be the cube root of two, namely, 1·26 : 1. Taking 1 inch as a basis and dividing by 1·26 we get 0·79 in.; and dividing this by 1·26 we get 0·63 in. By successive divisions we get the results given in the table on the next page prepared by Mr. Hoover. The width of the aperture is estimated as being equal to that of the wire and the corresponding number of holes per inch is given in each case. In making these calculations Mr Hoover took the more exact figure for the cube root of two, of 1·2599208635, for it is obvious that with 30 successive sub-divisions a substantial error would otherwise ensue.

Rittinger's series of apertures is based on the ratio of the areas of successive holes being 2 : 1, and this does not give a sufficient number of different sizes for modern requirements. This defect is remedied by the system now proposed, for it includes 11 screens within the usual range of experimental work. By a curious coincidence it has the advantage of providing a definite proportion between the measurement of the holes in English and French units, for it happens that the ratio of inches to millimetres, 25·3995, is the 14th power of the cube root of two. That is, the two series of figures in the inch and millimetre columns are identical, but the inch figures moved 14 places up. The two papers treat the subject in thorough detail as befits the nature of the proposal. Mr. Stadler gives tables comparing the system with the standards of the I.M.M. and the Mines Trials Committee, and Mr. Hoover gives his experience of the ease with which screens to suit the system can be obtained from makers.

Mr. Stadler also includes in his paper a discussion of the method of calculating the relative efficiences of different crushing machines, based on an examination of the results of classification by screens. Kick's law says that "the energy required for producing analagous changes of configuration of geometrically similar bodies varies with the volumes or weights." On this supposition, if the percentage of each screen-product is multiplied by the number of energy-units required for the reduction to the particular size, and the whole added, multiplied by the total ore per unit of time, and divided by the horse-power used, we get the relative mechanical efficiency of the crusher. It is not necessary to go into the theory of the calculation, for it proceeds on a line similar to that described by R. W. Chapman in a paper read before the Australasian Institute of Mining Engineers last year and quoted at length in our issue of January. Mr. Chapman took the general case of reduction of one size to any other size, and showed how to apply it to the I.M.M. screens. With Mr. Stadler's system of screens the relative power required to reduce one size to another is made particularly simple, because all that is wanted is the use of the ordinal numbers from 1 upward to represent the successive halving of the volumes. Thus starting from 1 hole per linear inch and successively dividing, as in Mr. Hoover's table, then the following meshes: 20, 25, 30, 35, 40, 50, 60, 75, 90, 110, 130, will be the 14th, 15th, 16th, 17th, 18th, 19th, 20th, 21st, 22nd, 23rd, and 24th successive subdivisions. This latter series of ordinal numerals constitutes the respective energy-units required to reduce the material from 1 in. size to the corresponding mesh. Therefore if we have a screen-analysis and multiply the ordinal numeral of each mesh with the percentage amount going through each mesh, and add the totals, we get the mechanical value of the whole crushing. By subtracting the figures, thus obtained, for the feed from those relating to the discharge, we get the work done per unit of material. Multiplying this by the tonnage treated per unit of time and dividing by the horse-power, we obtain a figure representing the efficiency of the machine. Mr. Stadler's detailed examples of the application of this method to tube-mills and stamps shows an efficiency strikingly in favour of the latter.

Width of Aperture		Meshes per Inch
Inches	Millimetres	
1 0000	25·3995	0
0·7937	20·1585	1
0 6300	15·9999	1
0·5000	12·6998	1
0 3969	10·0793	2
0 3150	7·9999	2
0·2500	6·3499	2
0·1984	5·0396	3
0·1575	4 0000	3
0·1250	3·1749	4
0·0992	2·5198	5
0·0787	2·0000	6
0·0625	1·5875	8
0 0496	1·2599	10
0 0394	1·0000	12
0 0313	0·7937	15
0 0248	0 6300	20
0 0197	0·5000	25
0·0156	0·3969	30
0 0124	0·3150	40
0 0098	0·2500	50
0·0078	0·1984	65
0·0062	0·1575	80
0·0049	0·1250	110
0·0039	0·0992	130
0·0031	0·0787	160
0·0025	0·0625	200
0·0020	0·0496	250

Heavy Stamps.—E. J. Way, consulting-engineer to the New Kleinfontein, in the May *Bulletin* of the Institution of Mining and Metallurgy contributes a criticism of W. A. Caldecott's paper on the development of heavy stamps. He shows that Mr. Caldecott does not make out a case for the greater crushing efficiency of the heavy stamp, but only for a greater capacity. Indeed, seeing that in Mr. Caldecott's experiments the heavy stamp used more water per ton of ore and the proportion of +60 was increased, there was really a decrease of efficiency. Mr. Way also combats Mr. Caldecott's four claims for the heavy stamps relating to the general decrease of initial and current costs, and points out that the first cost of foundations and constructional work is far greater with heavy stamps than with light stamps, and that the increased size of the ore-bins for heavy stamps compensates, as regards space occupied, for the smaller area covered by the stamps. In calculating first cost allowance must also be made for the additional plant required in the tube-mill circuit and for the buildings in which it is housed. As regards the cost of running, Mr. Way considers that the expense for wear and tear will adversely affect the bill in the case of heavy stamps, while the increased cost of supervision in connection with the tube-mills will more than counteract the lower cost of labour per ton in connection with the heavy stamps.

Mr. Way points out that the results obtained by the Mines Trials Committee elucidate the question of the efficiency of the heavy stamp. This committee found that the maximum mechanical efficiency when using heavy stamps is only obtained by crushing through correspondingly coarse screens; in other words, for every mesh there is a corresponding stamp-weight which would secure the highest efficiency. From this point of view the general aspect of the question changes. The reason for the two-stage crushing is really that with large and heavy stamps efficiency can only be obtained by the adoption of unusually coarse crushing. Mr. Caldecott stated that "the heavier the stamp the coarser the preliminary breaking admissible and *vice versâ*." Mr. Way, expanding the last two words thus: "the lighter the stamp the finer the preliminary breaking admissible," considers this proposition the basis for future guidance and urges that the function of a heavy stamp should be to prepare the ore for reduction and almagamation in light stamps. This plan would be in consonance with the results obtained by the Mines Trials Committee. Under these circumstances the economic limit of weight of the heavy stamp, leaving mechanical difficulties out of consideration, would be reached only when they encroach on the province of the jaw-breaker or gyratory crusher. Even with the coarsest crushing by heavy stamps there is a substantial proportion of minus 90 formed; and the lighter stamps following the heavier would be of smaller total capacity seeing that some of the ore, being already fine enough, would be eliminated.

Mr. Way is not convinced with regard to the claim that the recent fall in working costs on the Rand is due to the adoption of the tube-mill. His experience goes to show that the lowering of the cost of treatment is due to the increase in the scale of operations and the cheapening of labour and supplies. At the New Kleinfontein, Mr. Way has never adopted tube-mills, and yet his reduction expenses are lower than most of the double-stage plants. The difficulty of apportioning the cost, owing to the variety of methods of accounting renders it impossible to give an accurate comparison. Nevertheless the table of costs at 30 mills on the Rand presented by Mr. Way is sufficient to show that he has abundant arguments on his side.

COMPANY REPORTS

Crown Mines.—This company was formed on July 1 of last year and is a consolidation of Crown Deep, Crown Reef, Langlaagte Deep, Robinson Central Deep, and Langlaagte Royal, all dividend-payers, Paarl Central, a producer not yet paying a dividend, and other properties as yet undeveloped. The control is with the Wernher-Beit group; G. E. Webber is consulting engineer, and R. C. Warriner is general manager. The company is in law a continuation of the Crown Deep company, so that the present report for the year 1909 is a composite one, covering as to the first half-year the doings of the Crown Deep mine and as to the second half the operations of the new company. As regards the second half of the year, the report shows that 740,924 tons of ore was treated by 675 stamps. The yield was 8·128 dwt. per ton or 34s. 1d., and the working expenditure was 17s. per ton, leaving a profit of 17s. 1d. The total working profit was £634,084, and £611,068 was distributed as dividend for the half-year, being at the rate of 130% per annum. The reserve of developed ore on December 31 was 3,916,593 tons with an average content of 7·7 dwt. This figure does not show a great increase, a fact due to the nature of the development done during the half-year, work having been concentrated on the preparation of the consolidated properties for the new system of exploitation rather than on the enlargement of the ore reserve. Five new tube-mills and additional cyanide plant have been provided, and the monthly output will be increased to 157,000 tons per month. Two pumping stations have been added and a new steel head-gear has been provided for one of the shafts. The re-organization will not be finally completed for another two years. The cost of working has not yet been reduced and will not be until the re-organization is more nearly complete. In fact, the costs during the past half-year have necessarily been a trifle higher than when the mines were working individually, owing to the many temporary expenses. The benefit of this extra expenditure will be felt later. The life of the amalgamated mines is estimated at 50 years. The market quotation of the shares, nominally 10s., is £8¼.

Zinc Corporation.—This company was formed by Bewick, Moreing & Co. in 1905 for the purpose of treating zinc tailing at Broken Hill by flotation. The first processes adopted were not successful and the company's financial position became serious. Finally the Elmore vacuum process was adopted and the company is now a dividend-payer as far as the preference shares are concerned. The history of the various issues and re-arrangement of shares need not be recapitulated here; suffice it to say that there are 179,026 preference shares of £1 each and 453,132 ordinary shares of 16s. each. The preference shares take all the profits until they have received 100%; when this has been paid they take a cumulative preferential dividend of 20% and rank equally with the ordinary in the distribution of further profits. The first dividend was paid in September last, and for the year 1909 the holders of preference shares received 25%. The report for 1909 shows that during the year 227,502 tons of tailing was treated averaging 20·38% zinc, 5·8% lead, and 8·82 oz. silver. During the first six months the supply came entirely from the Block 10 dump, and later other material from the British Broken Hill dump was added, in a suitable proportion as determined in the experimental plant. The report does not give the figures showing the amount of concentrate produced by the Elmore plant, but states that the average assay-value was 43·48% zinc, 10·83% lead, and 16·43 oz. silver. On the removal of the gangue by the Elmore process the concentrate is sent to Wilfley tables in order to effect a further separation of the sulphides, with the special object of reducing the lead content. The final production was 84,698 tons of zinc concentrate averaging 46% zinc, 7·3% lead, and 15·08 oz. silver, together with 6411 tons of lead concentrate averaging 57% lead, 16·3% zinc, and 38¾ oz. silver per ton. When the Wilfley tables were erected it was supposed that twenty would be sufficient to handle the product from the

ZINC CORPORATION'S PLANT AT BROKEN HILL.

Elmore plant, but as the capacity of the latter was continually increasing it was found necessary to double the installation of Wilfleys. When these tables were overtaxed the separation of lead was not done efficiently, with the consequence that the zinc content of the concentrate was not raised as high as it should be. Since the new Wilfleys have been provided, the zinc concentrate has been raised once more to the more profitable grade of 47%. The zinc and lead concentrates produced during the year sold for £276,946. The treatment cost, including royalty, was £96,522, and £56,946 was charged towards the cost of purchase. In addition £21,043 was allowed for depreciation, and after paying expenses of administration, a profit of £100,867 was left. The year started with an adverse balance of £59,650, of which £29,650 was written off when the ordinary shares were reduced from £1 to 16s., and the remaining £30,000 has been liquidated out of the past year's profit. As already mentioned, £44,756 has been paid as dividend and £21,111 has been carried forward.

As regards the zinc tailing contracts, it may be noted that the payments have been made in full for the material purchased from the British Broken Hill, and that £31,000 has still to be paid to Block 10 in quarterly instalments, and £145,000 in similar instalments to Broken Hill South. At the meeting of shareholders held in May, consent was given to the scheme for purchasing an additional 550,000 tons of slimy tailing, at a price not disclosed. On December 31, the material on hand and paid for amounted to 1,225,000 tons and that purchased on contract to be paid for by instalments was 1,450,000 tons, making a total of 2,675,000 tons, sufficient to keep the plant supplied for 11 years.

City Deep.—This company owns property on the dip below the City & Suburban, Meyer & Charlton, Wolhuter, and New Goch, and belongs to the Wernher-Beit. W. W. Mein has until recently been consulting engineer and is now succeeded by H. Stuart Martin ; J. Whitford is manager. The company was formed in 1898, to acquire 190 claims immediately adjacent to the City & Suburban, and in 1908 the rest of the present property was acquired by consolidation and amalgamation. Active development was commenced two years ago. Two shafts 5000 ft. apart have been sunk, and are connected on the 8th level. At No. 1, or Wolhuter, shaft the South Reef was intersected at a depth of 2802 ft. and the Main Reef Leader at 3033 ft. Development has been prosecuted actively from both shafts and operations have been mostly confined to five levels on the Main Reef Leader. On December 31, 1909, the ore blocked out was 1,520,930 tons averaging 8.34 dwt. over a width of 60 inches. The content is highest at the fifth or top level, being 10.7 dwt., and the contents at the 6th, 7th, and 9th levels are 8.3 dwt., 9.3 dwt., 8.3 dwt., and 7.1 dwt. Most of the development has been done in the 8th or connecting level. The South Reef does not contain much profitable ore and the amount included in the reserve is only 10,513 tons averaging 4.7 dwt. over 55 in. It is estimated that above the 8th level 6,000,000 tons of profitable ore will be found on the Main Reef Leader, and the total life as far as the Main Reef Leader is concerned is 37 years. The metallurgical plant containing 200 heavy stamps is in course of erection and treatment should commence about the end of 1910. The tonnage will then be 65,000 per month, and additional plant will be provided later so as to increase the amount to 90,000 per month. The capital is £1,250,000, in 1,250,000 shares of £1 each, of which 1,227,305 have been issued. In February 1909, 30,000 shares were sold at £3. 2s. 6d., 30,000 in August at £3 7s. 6d., and 50,000 in December at £4. The amount of money so far spent on development and equipment is about £610,000, and the cash in hand on December 31 was £541,000.

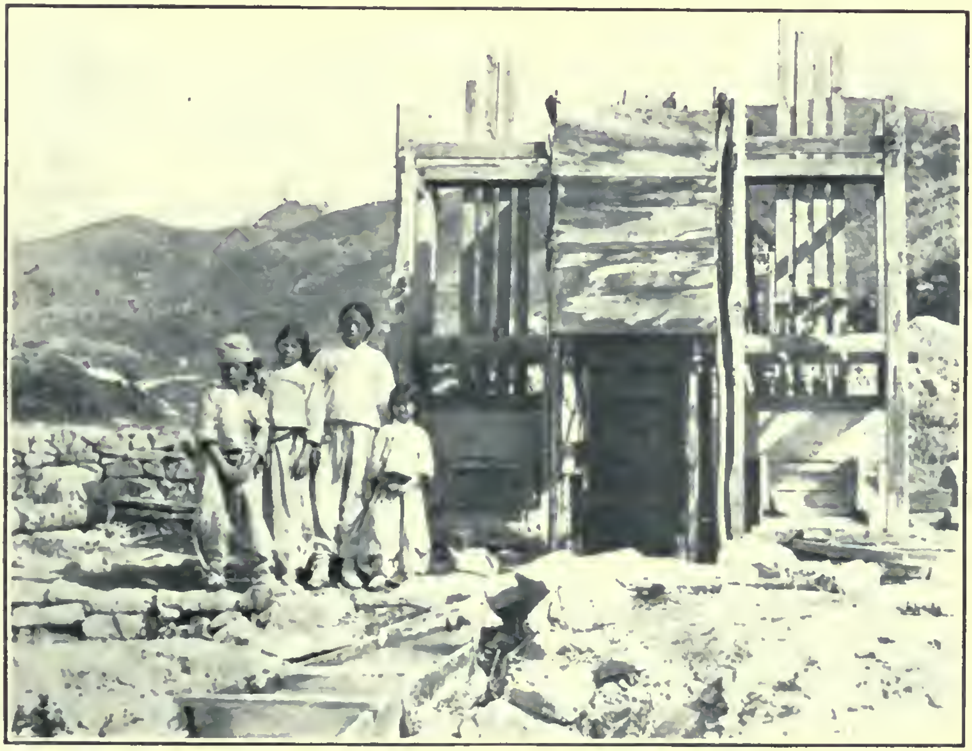
Rose Deep.—This company was formed in 1894 to acquire claims on the dip of the New Primrose in the eastern part of the Rand, and it belongs to the Wernher-Beit group. Operations started in 1897 with 100 stamps and subsequently another 100 stamps and four tube-mills were added. On December 1, 1909, the adjoining Glen Deep with 100 stamps was absorbed, and the report for 1909 covers 11 months relating to Rose Deep alone and 1 month to the combined properties. On this basis 472,800 tons was milled averaging 6.63 dwt., and the yield by amalgamation was 97,793 oz., or 4.137 dwt. per ton. The cyanide plant treated 471,285 tons and produced 49,407 oz. or 2.1 dwt. per ton, leaving 0.434 dwt. in the final residue. The revenue from the sale of gold was £617,809, or 26s. 1d. per ton milled, which is a figure almost identical with that of the previous year. The expenditure on mining, development, and reduction, and general expenses was £369,287 or 15s. 7d. per ton, a decrease of 9d. compared with 1908, leaving a profit of £248,522 or 10s. 6d. per ton. As there was a balance of £77,653 brought forward from 1908, it has been possible to distribute £280,000 as dividend. The ore reserve on December 31, 1909, was 3,496,265 tons averaging 6.2 dwt. made up as follows : 1,188,513 tons on the Main Reef averaging 6 dwt. over 59 in., 190,331 tons on the Main Reef Leader averaging 6.3 dwt. over 31 in., 520,598 tons on the South Reef, averaging 5.8 dwt. over 57 in., 412,735 tons on the Main Reef Leader and Bastard Reef combined averaging 6.5 dwt. over 54 in., and 1,184,088 tons in the Main Reef Leader and South Reef combined averaging 6.6 dwt. over 76 in. During the year 1909 the developments added 721,388 tons to the reserve, averaging 6.4 dwt. Re-arrangements of operations consequent on the amalgamation are now being made, one of them being the connection of the workings in the two mines. Preparations are also being made for the electrification of the plant. G. E. Webber is consulting engineer, and W. T. Hallimond is manager.

Village Deep—This mine is on the dip of the Village Main Reef in the central part of the Rand, and belongs to the Wernher-Beit group. The property includes that of the Turf Mines, which was absorbed in 1908. The first shafts of the original Village Deep mine struck the South Reef at 2011 ft. and the Main Reef Leader at 2075 ft., and the Turf shaft cut the same lodes at 3815 ft. and 3894 ft. respectively. Crushing started in January 1905. The reduction plant consists of 180 stamps and 6 tube-mills, of which 3 were added in August 1909. The report for the year 1909 shows that 531,500 tons was raised during the year mostly from the Main Reef Leader ; after removing 16% waste, 444,800 tons went to the mill. The assay-value of the mill-ore was 6¼ dwt. and of the waste 0.42 dwt. The stamp-mill yielded 89,168 oz. or 4 dwt. ton ; 325,076 tons of sand produced 35,855 oz. and 120,475 tons of slime produced 7364 oz. ; 0.52 dwt. and 0.18 dwt. was left in the residues respectively. The total production of gold was 132,387 oz., or 5.95 dwt. per ton, an actual extraction of 95¼%. The revenue was £555,238 or 24s. 11½d. per ton milled, a decrease of 1s. 9d. per ton compared with 1908. The expenditure was as follows: Mining and development £288,238 or 12s. 11½d. per ton milled, metallurgical treatment £90,127 or 4s. 0½d. per ton, general expenses £30,150 or 1s. 4d. per ton ; a total of £408,605 or 18s. 4½d. per ton, which is a decrease of 1s. 1d. as compared with the figures for 1908. The working profit was £146,633 or 6s. 7d. per ton.

Dividends at the rate of 15%, absorbing £159,100, have been paid during the year. Since the commencement of operations gold worth £2,064,509 has been won and £265,167 has been distributed as dividend; £1,029,078 has been spent on shaft-sinking and equipment, and £1,597,597 on working expenditure. As regards ore-reserve, it is estimated that on the Main Reef Leader the amount on December 31 was 1,611,795 tons averaging 5·86 dwt., and on the South Reef 266,325 tons averaging 5·14 dwt., reckoning on stoping widths of 70 in. and 56 in. respectively. There are also large blocks averaging 3 dwt. and 2½ dwt. on the two reefs respectively. The electrification of the plant is nearly complete, and it is also noteworthy that the ventilation of the mine has been improved recently by the installation of a Sirocco fan capable of exhausting 250,000 cu. ft. air per minute.

The present treatment consists of amalgamating in the stamp-battery and subsequently concentrating, but the best method has still to be ascertained, and experiments are being made. Some of the hand-picked ore has been shipped to the Tacoma smelters, assaying 9% copper, 2½ oz. gold, and 7 oz. silver per ton. The ore reserve on December 31 amounted to 172,450 tons averaging 14 dwt. gold and 1¾% copper. The above information is obtained from the report of the company for 1909.

British Broken Hill.—This company was formed in 1887 and owns Blocks 15 and 16 on the Barrier Range, situated between Block 14 and North Broken Hill. The operations at this mine have not been as satisfactory as at some of the others owing to low metal contents and high costs, and when the prices of metals are low the mine has to suspend work. For instance, since December 1907 no development or mining has been done. During this time attention has been directed to improvements in extraction, and the lead-mill has been remodelled, finer grinding and additional tables being adopted. Also a 10-unit Elmore vacuum-plant has been erected for the treatment of 400 tons per day of zinc tailing. It is expected that the lead and zinc plants will be ready to start in June, and with this new machinery the cost will be reduced and the output increased. Contracts have been made on favourable terms for the sale of the lead products to the end of 1911 and of the zinc products to the end of 1917. As regards the reserve of ore, the directors report that in Block 15 the amount above the 600-ft. level is about 160,000 tons, and that below that level little profitable ore has so far been found; in Marsh's section, 300,000



A PRIMITIVE STAMP-MILL IN KOREA

Seoul Mining.—This company is registered in Connecticut, U.S.A., and owns the Suan gold mine in the province of Hwang Hai, Korea. This mine and the accompanying concession was originally granted to an English company, the Korea Syndicate. As the results of operations were discouraging this syndicate suspended operations. Subsequently Messrs. Collbran and Bostwick took an option and were so successful that they formed the present company with American capital, giving the syndicate as purchase-consideration one-fifth of the shares. The capital of the Seoul company is $400,000. H. Collbran is president, A. H. Collbran is general manager, and A. R. Weigall is consulting engineer. A mill of 20 stamps has been erected and started operations on January 1 of this year. The ore is pyrite and contains gold, silver, and copper.

tons has been exposed, but as the vein passes out of the property the limit of the company's ore has been reached. Thompson's section is the only part that has much promise for the future ; here there is a shoot 17 ft. long and 40 ft. wide on the 800 ft. level, and operations will be concentrated at this point. The mine equipment allows for an extraction of 2500 tons per week : on this scale it is calculated that with lead at £12. 10s. per ton, silver at 25d. per oz., and zinc at £20 per ton, profits of £15,000 per year should be made on both the lead and the zinc mills. The financial position of the company has been strengthened by the deal with the Zinc Corporation with regard to the payment for the old tailing dump. The original contract called for the payment of £50,000 spread over a number of years. In August last a bargain was struck by which £40,000 cash down liquidated the debt. The receipt of this sum made it unnecessary for the British Broken Hill to raise further capital by the issue of debentures or otherwise. The company will devote the funds to the payment for the new plant.

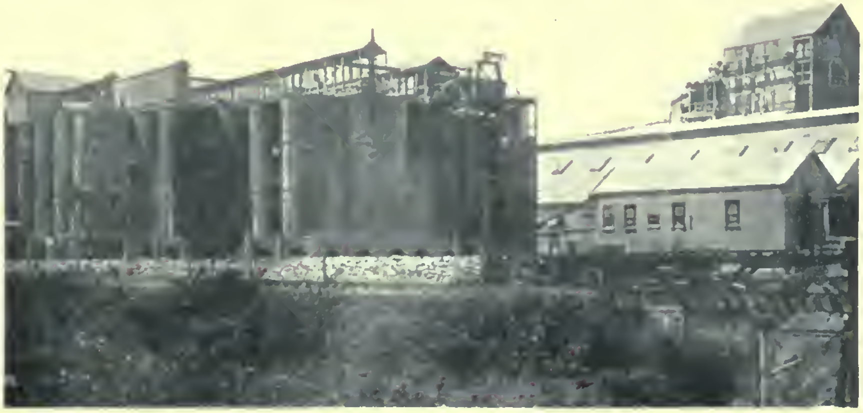
East Rand Proprietary.—This company, the first of the great consolidations on the Rand, constitutes the 'Farrar group.' The property consists of the Driefontein, Angelo, Comet, Cason, Blue Sky, and Angelo Deep, of which the first four are the most advanced in development and production. The area of gold-bearing claims is 2300 acres and the ore reserve on December 31 was 13,316,715 tons, or, after allowance for sorting, 11,371,761 tons of mill-ore averaging 5·7 dwt. This reserve of mill-ore is separated into 8,778,118 tons of profitable ore averaging 6·7 dwt., and 2,593,643 tons of unprofitable averaging 2·4 dwt. The figures of profitable ore may be further elucidated by mentioning that 1,622,727 tons assay 12·9 dwt. and 1,155,174 tons assay 7·7 dwt. Detailed discussion as to the advisability of including 2·4 dwt. stuff in the reserve would be of interest. The combined mills treated 1,830,280 tons during 1909, averaging 7·6 dwt. The stamps, numbering 820, yielded 362,551 oz. ; the sand-plants treated 1,293,656 tons and produced 204,746 oz., and the slime-plants 536,624 tons, producing 62,222 oz. The total production, including by-products, amounted to 635,908 oz. equal to 6·95 dwt. or 29s. 2d. per ton milled. The residues left in the sand and slime were 0·79 dwt. and 0·345 dwt. per ton. The figure for the sand-residue is high, and is caused by running the plants above their capacity, but the extra profit obtained justified this policy. The yield realized £2,671,749 and the working cost was £1,412,693 or 15s. 5d. per ton milled, leaving a profit of £1,259,057 or 13s. 9d. per ton milled. These figures do not account for the tax of £71,458, which makes the profit correspondingly less by 11d. per ton. The amount distributed as dividend was £898,356, which was 40% on the issued capital, and out of the profits £297,926 was appropriated for capital expenditure. The monthly tonnage was 157,000 in December and additional plant has been provided in order to bring the output to 175,000 tons and later on to 200,000 tons per month. The policy of this company is to adopt coarser crushing and provide more tube-mills. It is intended to concentrate operations at the Angelo and Cason plant, by transferring the tube-mills from Driefontein and Comet and providing additional tube-mills. The stamps at the latter plants will go out of use.

Mount Lyell.—The report of this mine for the half-year ended March 31 shows that 190,396 tons was smelted during the year, of which 122,816 tons came from the Mount Lyell mine and 67,580 tons from the North Mount Lyell. The average content was 2·61% copper, 1·89 oz. silver, and 0·78 dwt. gold per ton. The blister copper produced was 4164 tons, containing 4114 tons copper, 338,976 oz. silver, and 7627 oz. gold. The produce of blister copper was 374 tons less than in the previous half-year owing to the lower content of the ore treated. In addition to the ore smelted, 6143 tons of sulphur ore was used for the manufacture of acid. At the beginning of the half-year 1295 tons of copper was unsold ; this has since been sold at an average price of £59. 1s. Of the copper produced during the half-year 2755 tons brought an average price of £61. 11s. per ton and the remaining 1359 tons was carried forward. The profit for the half-year was £115,335, after allowing £6094 for taxes, £10,076 for depreciation, and £13,954 for exploration work. The dividend distributed absorbs £105,000, being at the rate of 1s. 9d. per £1 share. The cost of producing the blister copper was 16s. 4d. per ton of ore, 11d. higher than during the previous half-year owing partly to low grade ore from Mount Lyell being taken from the lower part of the mine, and partly to more coke being used in the charge. The coal strike also accounts for some part of the rise in cost. The reserve of ore is given as follows : At Mount Lyell available by open-cut, 539,042 tons averaging 0·6% copper, 1·93 oz. silver, and 0·86 dwt. gold per ton ; available by underground mining, 2,443,977 tons averaging 0·52% copper, 1·97 oz. silver, and ½ dwt. gold per ton ; at the North Mount Lyell, 842,163 tons averaging 6% copper, 1·33 oz. silver, and 0·1 oz. gold per ton. This is an increase in the reserve at North Mount Lyell during the year of 75,000 tons and the reserve now stands at the highest figure recorded. An important new orebody has been discovered on the 850 ft. level, and developments on the 1000 ft. level have been excellent. On the 1100 ft. level the orebodies are of as good quality as any found hitherto, a fact that gives great hope for the future. The underground reserve at Mount Lyell is now being utilized. As regards outside interests, the Chester mines will soon be producing regularly, and small parcels have already been despatched to the acid works. Prospecting has been continued with encouraging results at the Frankland River properties on Norfolk range, and has been started at the Hazelton group. The coal strike interfered with the coke-ovens at Port Kembla and operations were suspended for several months, but the smelter was not inconvenienced because a large reserve of coke was in hand. The production of fertilizers has been well maintained at Yarraville and Port Adelaide, though the latter operations were impeded to a small extent by the strike. The new fertilizer works at Fremantle will be ready to commence production shortly.

Nipissing.—This is one of the two leading producers at Cobalt, Ontario, La Rose being the other. The report of 1909 shows a most prosperous state of affairs. Not only was the dividend $1,500,000 or nearly twice as much as in 1908, but the ore reserve has been more than trebled. The company owns an extensive tract, surrounding Cart and Peterson lakes and bordering on Cobalt lake, covering 846 acres, and not much more than half of it has as yet been prospected. The shipments for 1909 amounted to 6412 tons, containing 4,646,876 oz. of silver. They were classified as follows : 7·6 tons of nuggets containing 150,844 oz., 1047 tons high grade ore containing 3,241,259 oz., 5174 tons of silicious ore containing 1,098,167 oz., and 183 tons of concentrates containing 156,606 oz. The gross value of the silver content was $2,395,430, and in addition 177,706 lb. of cobalt and 117 lb. of nickel were included in the metal to be paid for, the values of the respective amounts being $19,833 and $14, bringing the gross market value of the ore to $2,415,277. Against this had to be set the smelters' deduction from the silver content $119,822, treatment charges $47,967, freight $71,688, and other expenses in selling $23,747, leaving $2,178,280 as the net proceeds of the sales. Mining cost $383,152 and concentration $35,434, while depreciation $49,799 and expenditure in shafts $71,039 were charged against revenue. The profit was therefore $1,687,228, and as already mentioned $1,500,000 has been distributed as dividend, which is at the rate of 25%. The estimation of ore reserve is naturally a difficult problem owing to the number and thinness of the veins and the continual variation in width and content. The estimate made by R. B. Watson, the general manager, gives a total of 6,539,200 oz. Prospecting has been actively prosecuted during the year by means of trenching the surface and 24 new veins have been found. These have been numbered 109 to 132, and of them No. 122 promises to become one of the best ever found. It is intended within a short time to adopt the method of entirely stripping the overburden and so exposing the whole of the rock surface, thus ensuring that no vein shall be missed. No fine mechanical concentration is done at the mine. High grade hand-picked ore and screenings are sent to the smelter, and lower-grade screenings and ore are sent to the Nipissing Reduction Co. for treatment.

Waihi.—The yearly production of gold and silver at the Waihi, the premier mine of New Zealand, has increased steadily with never a break or setback since operations were started in 1890. The yield for 1909 was 190,912 oz. gold and 1,414,367 oz. silver, obtained from 416,813 short tons of ore, dry weight, and selling for £959,594. The total production to date has been worth £8,180,218, and the dividends £3,810,548. During 1909 the mining, milling, and development costs were £363,851; in addition £36,151 was spent on new plant, £36,963 was allowed for depreciation, and £40,778 has been allocated to the fund for providing electric current as described later. The dividends for the year absorbed £485,161, or 90% on the nominal capital, and £38,845 has been provided for income tax. The mine contains a number of lodes, as described in A. M. Finlayson's article on Waihi in our April issue. Of the ore mined during 1909, the largest proportion came from the 7th and 8th levels on the Martha lode, the amount being just over 200,000 tons. The Royal lode yielded 74,818 tons, the Welcome 48,407 tons, the Empire 45,304 tons, and the Edward 38,430 tons. The reserve on December 31 was estimated at 1,335,586 tons. The metallurgical equipment comprises 330 stamps and 15 tube-mills. The plant is divided into three separate mills, the Waihi with 90 stamps and 4 tube-mills, the Victoria with 200 stamps and 10 tube-mills, and the Union with 40 stamps and 1 tube-mill (the latter put in commission during August last). As mentioned above, the company has a scheme on hand for generating electricity at Hora Hora rapids, 50 miles away, and a licence has been obtained from the Government to erect a plant of 10,000 h.p. capacity. The company has a reserve fund invested in Government and similar securities amounting to £249,000.

New Kleinfontein.—This mine belongs to the Anglo-French Exploration group and is situated on the outcrop in the far East Rand between Benoni and Van Ryn. The consulting engineer, E. J. Way, has not been converted to the tube-mill idea, and consequently Kleinfontein is the only notable mine on the Rand where this machine is not found. Milling started in 1894, but the whole of the plant was destroyed during the war. Subsequently, in 1904, operations were recommenced with 220 stamps and cyanide plant. During the year 1909, 569,076 tons of ore was mined, and after the removal of 20% of waste, 454,945 tons was sent to the batteries. The yield under the stamps was 105,306 oz., in the sand-plant 41,020 oz., and in the slime-plant 10,845 oz., making a total of 157,171 oz., or 6·9 dwt. per ton milled. The yield was worth £668,497, or 29s 5d. per ton milled. The working profit was £296,361, but out of this other expenses had to be paid, namely, £2000 extra remuneration to the directors, £49,854 for sinking shafts and additional plant, and £21,467 taxes, so that the actual profit was £223,040, and the total cost £445,457. The figures per ton milled were: cost 19s. 7d. and profit 9s. 10d. The amount distributed as dividend was £225,000, being at the rate of 25% for the year. It will be noted that in estimating cost and profit we have included



BROWN AGITATOR-VATS AT WAIHI.

every item of expenditure. If only 'working cost' is considered, the figure is 16s. It is interesting to note the cost of crushing and extraction: crushing, sorting, and tramming, £16,977; milling £56,365; treatment of sand £20,967; slime treatment £6083; total £73,196. The report also includes £18,365 for general charges and £18,694 for the maintenance of surface works, but as the nature of these items is not specified, it is impossible to arrive at complete figures for cost. The figures may be anything from 3s. 2½d. to 4s. 11d. per ton milled. The reserve on December 31 was estimated as follows: 587,386 tons, assaying 6·19 dwt., on the Main Reef, 327,526 tons, assaying 8·87 dwt., on the Upper Main Reef, and 223,687 tons, assaying 8·94 dwt., on the Main Reef Leader, a total of 1,138,599 tons assaying 7½ dwt., calculated over a milling width of 38½ in. This is an increase during the year, with a slight decrease in the content, due chiefly to a rearrangement of the valuation. The report refers to the flooding in January 1909. It was impossible for several weeks to keep the mill fully supplied and it was not until May that the water was entirely removed. It was then found that the two lower levels were full of slime and this took longer to clear away than the water. It is also interesting to note that the trials with the Holman stoping-drill have been successful and that these machines are now in regular use.

Rand Mines.—This company was formed in 1893 by the Wernher-Beit group for the main purpose of acquiring claims on the dip of the outcrop mines in the central part of the Rand, and financing their development. The subsidiary companies thus formed include the following 'deeps': Glen, Rose, Geldenhuis, Jumpers, Nourse, South Nourse, Ferreira, Crown, Langlaagte, Durban Roodepoort; in addition the company assisted in the development of and has acquired interests in South Rand, Jupiter, Wolhuter, Wolhuter Deep, City Deep, Village Main Reef, Village Deep, Robinson Central Deep, Paarl Central. Of these Crown Deep has recently been transformed into Crown Mines, absorbing Langlaagte Deep, South Rand, Paarl Central, Robinson Central Deep, among the above, and also Crown Reef and other properties. The report of Rand Mines for 1909 shows that the issued capital of the company is now £466,666 in 5s. shares, and there are no debentures, the whole of the £1,000,000 having been redeemed. The dividends from the various holdings in the shares of the above named companies amounted to £1,120,049 during 1909, and in addition a profit of £861,283 was made by the realization of shares. As the shareholdings appear in the balance sheet at par it is clear that large profits are available by their sale. The dividend and bonus distributed during the year absorbed £1,600,977, and there is a balance of £1,090,952 carried forward.

McKinley-Darragh-Savage.—The property of this company consists of the McKinley-Darragh mine situated on the southwest shore of Cobalt Lake, Ontario, the Savage mine further south on Cart Lake and the Bennett claim. P. A. Robbins is general manager. The report for 1909 shows that 1,235,349 oz. of silver was produced at the McKinley-Darragh, and 62,181 oz. at the Savage, making a total yield of 1,297,530 oz. This is just double of the yield for 1908. The Savage commenced production in 1908, and the output at McKinley-Darragh was only 42,673 oz. in 1906. The total yield to date of the two mines is 2,722,922 oz. The amount of ore and concentrate from the two mines sold to the smelters during 1909 contained 1,324,908 oz. of silver valued at $679,813. Deducting treatment charges, percentage not paid for, arsenic penalty, and freight, the net return was $614,265. The working expenditure during the year was $228,935 and the cost of new plant $51,924. A dividend amounting to $224,493 was paid, being 10% on the issued capital.

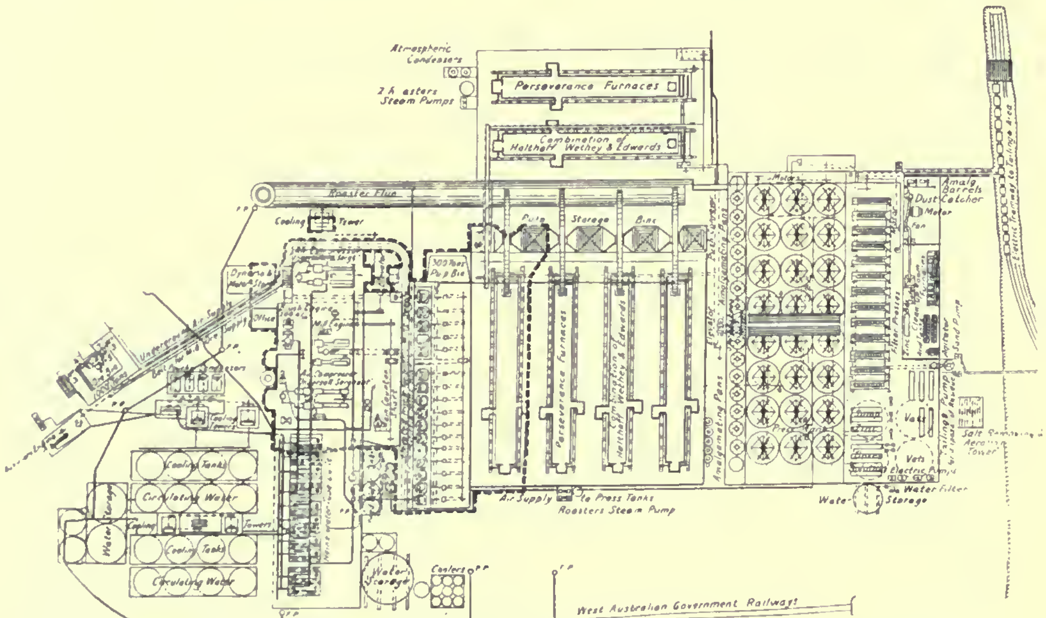
The marketed products from the McKinley-Darragh mine are classified thus: nuggets weighing 1350 lb., containing 13,305 oz.; 135 tons of No. 1 ore, containing 494,981 oz.; 178 tons of jig-concentrate, containing 386,149 oz.; 235 tons of slime concentrate, containing 70,212 oz.; and 122 tons miscellaneous products, containing 36,380 oz. At the same mine 16,824 tons of ore was hoisted during the year and 18,703 tons milled, from which it will be seen that the ratio of concentration is approximately 20 : 1. The ore reserve on December 31 was estimated in round numbers at 100,000 tons averaging 49 oz The working cost was $5·09 for mining, $2·20 for milling, and $1·69 for general expenses, per ton mined, a total of $9·00. As a matter of fact 10,000 tons of waste rock was also hoisted, and if this was included in the returns, Mr. Robbins could show a decrease in the working cost, the total figure then being only $5·56. But Mr. Robbins does not sacrifice to the fetish of low cost per ton

The new mill of the McKinley-Darragh commenced operations on February 8, 1909, with 10 stamps and the remaining stamps started on March 11. It was not until May that operations got into stride, and since then the daily capacity has been gradually increasing until in January of this year the capacity was 83½ tons per day and the milling cost was $1·48 per ton. The mill is operated only 6 days per week; coarse crushing and jigging are done in one shift, and the rest of the plant works day and night. During the year a further 10 stamps were erected together with a Hardinge mill and 22 concentrating tables. These will shortly start work, when the daily capacity will be 120 tons. The 30 stamps weigh 1250 lb. each.

At the Savage mine, the shipments for 1909 consisted of 23 tons of No. 1 ore containing 51,890 oz. and 65 tons of screening containing 7512 oz. The reserve is estimated at 10,300 tons averaging 75 oz. At the present time the mill operations consist only of picking the nuggets, then screening into four sizes, of which the finest goes to a Wilfley, the coarser to a picking table, and the two intermediate to jigs. The hutch product of the jigs goes to the Wilfley, and the reject from the picking table goes temporarily to the dump until such time as a stamp-mill is erected or arrangements are made for the transference of the ore to the McKinley-Darragh mill.

Tronoh.—In our September issue we gave an outline of the present position to this tin mine in the Kinta district of Perak and showed that attempts were being made by the new manager, H. D. Griffiths, to place the mine in a better position. The former management had neglected to properly protect the surface workings from collapse and there was consequently a danger of the whole mine being lost. R. J. Frecheville agreed with Mr. Griffiths that open-cut working should be abandoned. During the past year the surface has been filled and made more regular, thus preventing the accumulation of water and slime which previously used to cause dangerous rushes and floods. Underground the method has been adopted of working the deeper levels during the rainy season and the upper during the dry months. The whole of the 'karang' is now extracted instead of leaving poorer qualities behind. All these methods have been adopted so as to make the settlement more even and regular, and to prevent as far as possible the accidents due to caving. The average content of the ore is lowered but the safety is increased. This part of the property is known as No. 1 mine. In some parts it has been worked to bedrock, and the deposit cannot last much longer. Additional pumps have been provided in order to drain the underground water from the ground known as No. 2 mine, and the pumping capacity is now 3,000,000 gal. per day. By this means the water level has been reduced and it is now possible to start sinking shafts and prosecute mining and development. Development has also been commenced on No. 3 mine. During the year 1909, the amount of 'karang' mined was 292,825 cu. yd. and 2159 tons of tin concentrate was recovered. This sold for £167,755 or £80. 10s. per ton. The amount mined in 1908 was only 156,366 cu. yd. producing 1712 tons of concentrate. The cost at the mine was £115,937 and general expenses, depreciation, and taxes brought the expenditure to £137,187. The total income was £175,962 leaving a balance of profit of £38,774. The year commenced with a balance of £42,216; dividends at the rate of 10% absorbed £16,000, and £49,016 has been written off the property account, leaving £15,974 to be carried forward.

fire in the grinding and adjacent departments. As has already been recorded in our columns, the fire occurred on November 10, and destroyed the Griffin mills, the main driving engine, two air-compressors, electrical plant, and part of the boiler-house, roasting-furnaces, and belt-conveyor. A sum of £22,340 has been recovered from the insurance companies, but the total cost of renewals will be over £40,000. All milling operations have been suspended and cannot be resumed until the new plant is in place in July next. In the meantime development has been prosecuted actively and 11,395 ft. of work was done in 1909 as compared with 7699 ft. in 1908. The ore reserve on December 31 was estimated at 380,772 tons averaging 6½ dwt. or 27s. 10d., and there was also 249,080 tons in the mine averaging 4·94 dwt. classed as 'probably profitable.' Other bodies of ore are known to exist but as their contents are not sufficiently investigated they are not included in the estimate. The main shaft is down to 2074 ft. During the year 1909, that is, from January 1



PLAN OF GREAT BOULDER PERSEVERANCE PLANT.
The part destroyed by fire is enclosed within the thick dotted line.

Great Boulder Perseverance.—This was in its earlier years one of the high-grade mines at Kalgoorlie, but in 1905 the ore reserve was found to have been exaggerated and the control and management passed into other hands. Hooper & Speak were appointed consulting engineers and subsequently general managers, their Australian partner Ernest Williams assuming local responsibility. Under their direction extensive prospecting and development work revealed the presence of orebodies averaging 7 dwt. and under the new conditions the company has continued to make a profit. One of the last acts of the old controllers was to expand the nominal capital to £1,500,000 and on this exaggerated figure the present rate of dividend looks small though on the original capitalization £175,000 would have been handsome. The company had a bad stroke of luck last year in the form of an outbreak of

to November 10, the tonnage treated was 192,178, and the production was 70,681 oz. gold and 7829 oz. silver, with a total value of £300,949. The working cost was £185,422, and expenditure on development work £40,263. The disposable balance of profit for the year was £56,837. The directors have decided to write off as lost the loan of £46,938, which Frank L. Gardner as director and controller lent to himself personally in years gone-by. It may seem remarkable that a director should be able to draw on his company to this extent, but in justice to Mr. Gardner it must be remembered that in early days when the sulpho-telluride ore caused such difficulties he spent out of his pocket and without recompense more than this sum of money for the purpose of putting the company into a paying condition. After writing off this amount as lost, the profit for the year is reduced to £9899. In order to equalize dividends, the sum of £50,000 has been taken from reserve and a dividend of 2½%, absorbing £34,986, has been paid. It had been intended to pay double this rate for the year, but the fire in November rendered it impossible.

We publish herewith a plan of the crushing and extraction plant, showing the extent of the fire. The treatment at this mine is different from the usual practice at Kalgoorlie. The ore is first crushed to the finest slime, then roasted, sent to amalgamating pans, and finally to cyanide plant and filter-presses. In the destroyed plant, the comminution was done in Griffin mills, but in the new plant these are to be replaced by Krupp ball-mills and tube-mills.

New Primrose.—This mine belongs to the Barnato group and is situated in the eastern part of the central Rand, immediately to the east of Simmer & Jack. Milling began in 1889, and since 1895 a 160-stamp mill has been in operation. Dividends were paid first in 1891 and have been regularly maintained. The report for 1909 shows that £178,750 was distributed on account of the year's profits, being at the rate of 55% on the capital. During the year 282,614 tons was raised of which two-thirds came from the South Reef, and most of the remainder from the Main Reef; 18% was removed by sorting and 231,063 tons was sent to the battery, of which an average of 125 stamps were running during the year. The content of the ore sent to the mill was 7·39 dwt., and the yield by amalgamation was 52,957 oz. or 4·58 dwt. per ton. The cyanide plant treated 161,519 tons of sand yielding 24,486 oz., 69,697 tons of current slime yielding 5706 oz., and 51,913 tons of accumulated slime yielding 6302 oz. The recovery of gold from the sand was 2·12 dwt. per ton of ore milled, and from current slime 0·5 dwt., the total extraction in the battery and cyanide plant being therefore 7·2 dwt. per ton milled or 97%. The content of the accumulated slime was estimated at 2·85 dwt. and the recovery was 2·43 dwt. The recovery from the ore milled was 30s. 7d per ton and the yield from the accumulated slime and other sources of revenue brought the total income to 32s. 9d. per ton. The working cost was 17s. 2d. so that the profit was 15s. 7d. per ton milled. The ore reserve on December 31 was 504,531 tons, and the developments during the year were approximately equal to the amount hoisted. J. Harry Johns is consulting engineer and A. E. Payne manager.

Jupiter.—This mine belongs to the Consolidated Gold Fields group and is immediately to the west of Simmer Deep. These two mines have a metallurgical plant in common, consisting of 300 stamps and 4 tube-mills; of the stamps 200 are ordinarily used for Simmer Deep ore and 100 for that coming from Jupiter. Reduction operations commenced in September 1908. The report for 1909 shows that during the year the 100 stamps treated 267,688 tons; 241,653 tons was taken from the mine, 69,106 tons from the dump, and of the total 14½% was removed by sorting. The yield of gold in the stamps was 34,287 oz., and in the tube-mills 9267 oz. The cyanide plant extracted 21,395 oz. from 161,159 tons of sand and 7117 oz. from 106,529 tons of slime. The total yield was 72,066 oz. valued at £302,596, or 22s. 7d. per ton milled. The working expenses were £217,446 or 16s. 3d per ton, leaving a profit of 6s. 4d. per ton. The joint plant is now being doubled and the plant available for Jupiter ore will before long be 200 stamps and 8 tube-mills. The total joint output will shortly be 120,000 tons per month, of which the Jupiter proportion will be 48,000 tons. The reserve of ore on December 31 was estimated at 1,215,000 tons averaging 6 dwt.; and large blocks of lower grade rock have also been exposed. The dividend (No. 1) declared for 1909 was at the rate of 5% and absorbed £50,710. The company has a large amount of cash capital in hand, sufficient to pay for the extension of plant.

Namaqua Copper.—This company owns copper mines at Concordia, Little Namaqualand, Cape Colony, not far from those belonging to the Cape Copper Co., whose railway to Port Nolloth is used for communications and transport. The matte produced at the Namaqua is sold to the Cape Copper Co and treated at the latter's works in South Wales. Operations started in 1887, and though the deposit is not easy to work and the ores not readily amenable to concentration, some good profits have been made. Naturally the price of copper dominates the situation. In 1906 the dividend was 35% on the capital of £200,000, but in 1907 it was only 12½% and nothing has been distributed during 1908 and 1909. The report for 1909 shows that 31,578 tons of ore and 9101 tons of concentrate, flue dust, and rich slag, a total of 40,679 tons, was smelted. The two furnaces were in commission during the first nine months of the year, but subsequently only one was working; the tailing and low grade ore was omitted from the charge of the single furnace, and the rate of smelting was accordingly improved and the amount of coke decreased. The output was 4690 tons of matte and bottoms containing 2292 tons of copper. The board contains the names of men prominent in the metal trade, and William Rich is also a director. S. F. Phillips is manager at the mine and H. H. Lewis is metallurgist.

Great Fingall Consolidated.—This gold mine is situated at Day Dawn, Western Australia, and is managed by Bewick, Moreing & Co., G. C. Klug being superintendent. Milling commenced in 1900 with 20 stamps, and since then the plant has gradually been extended until it now consists of 100 stamps, with concentrators, roasting furnaces, and cyanide plant. Unfortunately during the last two years the developments have been unsatisfactory and towards the end of 1908 the average content of the ore sent to the mill was considerably reduced. The report for 1909 shows that no further bodies of ore have been discovered, and only 40 of the 100 stamps have been at work. The policy of the managers is to attack the rich pillars left in the mine. This cannot be done without first filling the stopes with sand and the latter work is now in hand. The company also owns approximately a quarter of a million tons of accumulated slime that has been hitherto considered unprofitable. This is now to be treated by the vacuum slime plant recently erected. During 1909, the 40 stamps in operation crushed 140,982 tons yielding by amalgamation 21,074 oz.; 1877 tons of concentrate produced 6039 oz., 105,225 tons of sand 8042 oz., 19,339 tons of current slime 1333 oz., and 77,280 tons of accumulated slime 4781 oz., a total production of 41,269 oz. The income from the sale of gold was £175,716 and £2900 was received as interest. The cost of treatment was £156,300, the London expenses were £3150, depreciation £9181, and taxes £9240, leaving a margin for the year of only £320. In addition £25,888 was spent on capital account for developments and new plant The company commenced the year with a balance in hand of £24,339, out of which £21,875 has been distributed as dividend, being at the rate of 8¾%. Irrespective of the rich pillars, the available ore reserve on December 31 was 49,460 tons averaging 23s. 9d. per ton. Owing to the insecurity of the workings it is impossible to enter them for the purpose of measuring the other ore or the pillars until the sand-filling is in place.

BOOKS REVIEWED

Oil-Shales of New Brunswick and Nova Scotia, and the Oil-Shale Industry of Scotland.—By R. W. Ells. Pamphlet, 75 pages. Ill. Ottawa: Department of Mines.

This publication gives an account of the tests made by W. A. Hamor on New Brunswick oil-shales at the works of the Pumpherston Oil Co.'s works in Scotland; and it includes descriptions of the distribution of oil-shale in Canada and Scotland, and of the methods of mining, extraction, and refining adopted in Scotland. The 'Albert' shales in Albert and Westmorland counties, New Brunswick, have been known for many years, and at various times large sums of money have been spent in attempts to work them. Finally in 1907 the leading company in the district, The Albertite, Oilite, and Cannel Coal Co. of New York, despatched 50 tons to Pumpherston in order to obtain a practical test. The work was done under the direction of W. A. Hamor, of the University of the City of New York. The Canadian Mines Department considered this move as being of interest to Canadians generally, and accordingly R. W. Ells was sent to Scotland to be present at the tests. The experimental retort at Pumpherston treated 36¾ tons and produced 1473¼ gal of crude oil having a specific gravity of 0.919, or 40.09 gal. per ton; in addition 76.94 lb. of sulphate of ammonia was produced per ton of shale. The first part of the pamphlet gives a record of the details of the experiments and of those relating to the refining and fractionation of the crude oil. The next division of the pamphlet gives an account of the technology of the Scottish shale oil industry written by Mr. Hamor, and afterwards follows a treatise on the oil-shale deposits of Canada by Mr. Ells, with an appendix on the geology of the Scottish district.

The Miner's Guide.—By L. A. Atherley Jones, K.C., M.P., and Hugh H. L. Bellot. Cloth, 8vo. 390 pages. London: Methuen & Co.

This is not a guide to mining, but to the English law governing the relations between employer and employed, especially in connection with the Coal Mines Regulation Acts. These Acts are analysed and annotated, as are also the Employers and Workmen Act, the Compensation Acts, the Conciliation Act, the various Acts relating to trades unions, the Conspiracy and Protection of Property Act, and the Trade Disputes Act. The book is an excellent guide to the conditions of work in English coal mines and will therefore not only be a convenient handbook of the law but will be read with interest abroad. We congratulate the publishers on producing a 'light-weight' book. It measures 8 by 5½ by 1¼ in. and weighs less than one pound.

Flight Manual, A Reference Book on Aviation.—By Algernon E. Berriman. Pocket-size, 280 pages. Ill. London: St. Martins Publishing Co. Price 10s. 6d. For sale by *The Mining Magazine*.

The passage of the Channel by Bleriot, De Lesseps and Rolls, the dash to Manchester by Paulhan, and the journey by aeroplane to a police court to be fined for exceeding the motor speed-limit on the part of Graham-White are events that have impressed even the slowest intellect with both the charm and the practical side of aviation. This science is no longer the study of the select band of enthusiasts; it is followed by the multitude, technically trained or otherwise. A concise guide to the theory and practice of flight will therefore be widely welcomed.

This book has been compiled by Algernon Berriman, the technical editor of *Flight*, a weekly paper devoted to the subject. 'Compiled' is not quite the right word, for it is too often used to denote the perfunctory collection of miscellaneous information undertaken by unqualified journalists. Mr. Berriman's work is not of this nature. Being a trained mechanical engineer with an unbounded enthusiasm for the details of new methods of locomotion he has for years collected together all possible information likely to be of use in the pursuit of his studies and investigations. Everything in this book is therefore short, sharp, and to the point. The book commences with a history of flight, a biography of inventors and pioneers, and a description of various types of machines. Then follow chapters on aerodynamics, mechanical theory of flight, bird-flight study, the principles of mechanics and dynamics, physics and chemistry, strength of structures, motor-car laws in various countries, etc. But it is impossible to give in detail the great range of information condensed into a small space. The mechanical and scientific tables, notes, formulæ, etc., are of interest and use for other purposes than aviation.

Hints on Surveying, and the Keeping of Mine Plans and Reports.—By J. W. Teale. Pocket size, 40 pages, with large folding plate. London: *The Mining Magazine*. Price 6s.

This book is based on the system adopted by Mr. Teale for use by the staff of Bainbridge, Seymour & Co., of which firm he is a member. The part devoted to surveying does not teach the art but enumerates the requirements as regards mine-plans and gives precise directions for the representation of the various items recorded. In fact, it is an attempt to standardize mine-plans, so that if adopted generally any engineer could read another engineer's plans with facility and gain a great deal more information than is usually found on mine-drawings. The folding plate gives examples of the ways of representing 62 different features in a survey and they are all given in the colour to be adopted in the plan. This great variety of colour adds to the cost of production of the book. There are also rules for the colouring to be adopted for various rocks. The other part of the book gives tables for use in preparing returns from stamp-mills and cyanide plant, borehole records, assay-plans, sampling, developing, stoping, and so forth. It is an eminently useful publication.

NEW PUBLICATIONS

Index Map of Rhodesia Mines.—London: *The Financial Times*. Price 5s. For sale by *The Mining Magazine*.

Oil, Petroleum, and Bitumen Manual. — By Walter R. Skinner. Stiff paper covers. Octavo, 130 pages. Ill. London: The Offices of the *Capitalist*. Price 1s. For sale by *The Mining Magazine*.

With characteristic promptitude Mr. Skinner has issued the first edition of his reference book of oil companies. It has been prepared in the same style and form as his 'Mining Manual,' a fact that is sufficient indication of its value.

From Prospect to Mine.—By Etienne A. Ritter. Small 8vo., 140 pages. Ill. Denver: Mining Science Publishing Co.

This is an elementary book intended for investors and speculators in mining shares, describing prospecting, development, and general mining operations, the nature of ore deposits, methods of treatment of ores, and the routine of mining companies.

CURRENT LITERATURE

Origin of Laterite.—At the April meeting of the Institution of Mining and Metallurgy, a paper by J. Morrow Campbell was read on the origin of laterite. The author described the occurrence of gold-bearing laterite on the West Coast of Africa, particularly in French Guinea.

Cleveland Iron Industry. — The *Iron and Coal Trades Review* for May 20 publishes a paper by J. E. Stead read before the Cleveland Institution of Engineers on the 'Cleveland Iron Industry.' The paper is comprehensive and authoritative, and treats the subject under the following heads: Microstructure of the ore, genesis of the main deposit, presence of fossilized wood, minerals composing the deposits, analysis of the ore, effect of calcining, analysis of pig iron and slag, amount and constitution of charge.

Smelting Nickel Ores. — In *Metallurgical and Chemical Engineering* for May, C. T. Hennig gives some information about the utilization of the nickel ores found at Webster, North Carolina. The ores are hydrated nickel-magnesium silicates containing clay, ironstone, and chrome. The nickel compounds are garnierite and dunite. Attempts to concentrate, smelt, or leach the ores have been failures hitherto. Mr. Hennig has devised an electric furnace for producing a nickel silicide which will be suitable for introducing nickel into steel.

Electric Furnaces. — At the May meeting of the American Electro-chemical Society, T. Rowlands read a paper on electric furnaces of the induction type, treating in detail the progress of the Kjellin furnace and the Rochling-Rodenhauser modification used for large tonnages.

Spilsbury's Cyanide Agitator.—We gave in our last issue a short precis of E. G. Spilsbury's account of his silica sponge used for distributing air upwards in cyanide tanks presented to a meeting of the Mining and Metallurgical Society of America. A more complete paper on the subject by the same author is published in the May *Bulletin* of the American Institute of Mining Engineers. Results of tests at San Matias mill, Guanajuato, are given.

Electric Mine-Hoists.—In the May *Bulletin* of the American Institute of Mining Engineers is published a lengthy paper on electric mine-hoists written by D. B. Rushmore and K. A. Pauly, electrical engineers, of Schenectady.

Determination of Copper.—In the *Western Chemist and Metallurgist* for April, F. W. Traphagen gives an account of the method used at Anaconda for the colorimetric determination of copper in slag and tailing by the cuprammonium nitrate reaction. The method is a modification of Thorne Smith's and was introduced by H. N. Thompson. It consists essentially in preparing standard solutions from slags and tailing of known copper content instead of from pure copper.

Reverberatory Practice.—In the *Engineering and Mining Journal* for May 14 and 21, R. R. Moore gives a review of recent reverberatory smelting practice.

All-Sliming.—The *Engineering and Mining Journal* for May 21 describes the new cyanide plant at the Tonopah Extension Co.'s mine, Nevada, where all-sliming is adopted.

Copper Mining in Spain.—A series of articles on the copper mines of Southern Spain and Portugal is being published in the *Mining Journal*, commencing with the issue of April 30.

Chlorination.—In the *Australian Mining Standard* for April 27, Donald Clark describes the Edwards custom plants at Bendigo and Ballarat, where pyrite concentrates have been treated by the chlorination of over 34 years.

Concentrates at Kalgoorlie.—In the *Mining Journal* for May 21, W. M. von Bernewitz reviews the various methods of treating concentrates at the Horse-Shoe, Ivanhoe, Oroya-Links, Lake View, and Hainault mines at Kalgoorlie.

Pyrometry.—In the *Journal of the Franklin Institute* for May, C. E. Foster describes a pyrometer of the 'total radiation' type, the novel point being that it does not require focussing.

Clays.—In the *Journal* of the Society of Chemical Industry for April 30, a paper by A. E. Tucker is published discussing the formation and analysis of clays, especially china clay.

Mine Pillars.—Arthur Jarman, professor of mining at Auckland, N.Z., contributes a paper to the *Australian Mining and Engineering Review* for April on the strength of mine pillars, especially in connection with coal mines.

Mining Practice at Bingham. — In the *Mining World* (Chicago) for April 30, L. A. Palmer writes of the underground mining practice at Bingham, Utah.

Reverberatory Smelting.—In the *Australian Mining Standard* for April 6, H. Schroder describes the reverberatory treatment of copper ore and matte at the Lithgow works of the Great Cobar Co.

Electric Furnace. — At the April meeting of the Canadian Mining Institute, Alfred Stansfield described J. W. Evans' method for producing tool steel direct from ore in the electric furnace.

Determination of Sulphates.—In the *Mining and Scientific Press* for May 14, F. H. Mason describes a new rapid method of estimating sulphates devised by A. D. Mitchell and C. Smith.

NEW CATALOGUES

THE HARDINGE CONICAL MILL CO. have sent us their new catalogue. The theory of this mill is now well known, and for those who are slow to appreciate new ideas we may add that in practice its efficiency has been amply demonstrated. One of the 6 ft. mills has been at work for 18 months at the Standard mines, Cobalt, Ontario, and has reduced 20,000 tons of hard diabase rock from 6-mesh to 60-mesh, with a charge of 2000 tons of pebbles; the consumption of pebbles was ½ lb. per ton of ore and the horsepower 12½. It is of interest to note also that this mill has been recently adopted by the Calumet and Hecla, the Miami Copper Co., Arizona, the New Einasleigh Copper Co., Queensland, and the Grand Union Mining Co., Mexico. Fraser and Chalmers have been appointed special sales agents for the mill in Great Britain and Africa.

F. REDDAWAY & CO., LTD., Pendleton, Manchester, send us their catalogue of belt conveyors which are in extensive use for handling ore and disposing of tailing in many mines in Africa, Australia, etc. The catalogue also includes metallic conveyors intended for moving hot materials such as ashes and slag. This catalogue is also published in French, a great convenience for foreign customers.

HOLMAN BROTHERS, LTD., Camborne, have sent us their catalogue relating to their stoping drills. These have been much before the public recently owing to their success in South Africa. They also send their catalogues desc ibing the air-cushion or 'pneumatic' stamp, and the revolving buddle or 'Acme' table.

LOBNITZ & CO., LTD., Renfrew, have issued a catalogue of gold-dredges. The firm has supplied many dredges of varying capacity and design for Siberia, Burma, West Africa, British Guiana, Peru, the Straits.

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